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BRONCHIAL OBSTRUCTION

ITS RELATION TO ATELECTASIS, BRONCHOPNEUMONIA AND LOBAR PNEUMONIA

A Roentgenographic, Experimental and Clinical Study*

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FROM our experimental and clinical investigations on atelectasis and lobar pneumonia we came to formulate the theory that massive atelectasis and lobar pneumonia have a common pathogenesis and that both are secondary to bronchial obstruction of a large bronchus, so that lobar pneumonia can be designated by the name of "pneumococcic atelectasis," or better, "pneumococcic bronchial obstruction." In a series of papers we presented the experimental and pathological data upon which we based this conception.

As our work progressed, new facts were brought to light which not only corroborate this theory but, furthermore, show in more and more convincing fashion the great significance of bronchial obstruction for the production of bronchogenous inflammatory diseases of the lung. We think we are justified in stating that *bronchial obstruction*, when complete, interferes with ventilation, circulation and free drainage of the pulmonary area corresponding to the obstructed bronchus. Atelectasis, circulatory disturbances and pulmonary cellulitis will result. The particular stage of the first two conditions will depend upon the duration of the obstruction. The nature, severity and outcome of the latter condition (cellulitis) will depend upon the nature and virulence of the infecting microorganisms and on the duration of the obstruction as well. In incomplete bronchial obstruction bronchial stasis accompanied by emphysema is more apt to occur (obstructive emphysema described by Manges).

It is strange that the importance of bronchial obstruction in lung pathology has not attracted the attention of the internist and pathologist more than it has; for other organs such as the liver, pancreas, kidneys, etc., the impairment of normal drainage and the resulting lesions have been so thoroughly studied. We believe the reason for this is that in bronchial obstruction the clinical symptoms and even the physical signs are so variable at times that the underlying and determining cause is often difficult to discover.

Among these signs, however, there are

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a number which by their constancy can serve as sure guides in the search for the real etiological factor. These signs are

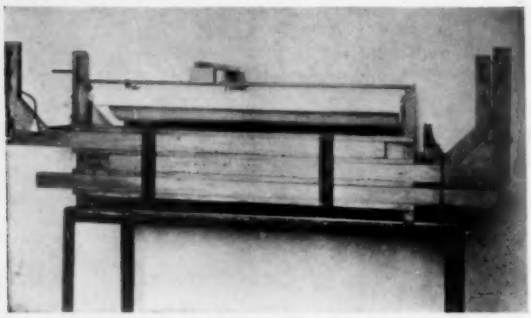


Fig. 1. Animal stand designed to secure symmetrical roentgenograms of the dog's chest.

obtained through *roentgenography* and *bronchoscopy*. In great part the progress accomplished in the past few years in pulmonary diagnosis and treatment in general, and more especially in thoracic surgery, is due to these methods of investigation. We are thoroughly convinced that this is only a beginning. Real progress will be accomplished when roentgenographic examination in chest diseases, especially with contrast media, is considered as much a necessity and a routine procedure as stethoscopic examinations (Rigler). At such a time, the internist will perhaps no longer insist upon not changing the position of the pneumonia patient, especially should various arbitrary distinctions between "medical" and "surgical" diseases of the chest be given up as obsolete and cumbersome. When chest diseases are investigated by a group of men—internist, surgeon, roentgenologist and bronchoscopist—working in close cooperation as a group, then knowledge in "chest pathology" will rapidly rise to the same level as the pathology of other systems.

In the present paper we shall briefly give our conception and clinical arguments in favor of and against our thesis; new data will be presented, relative to the circulation in the atelectatic and pneumonic lung, and the disturbance of gaseous exchange in the two conditions; a new classification of the lung diseases we are dealing with in this work will be given, based upon their pathogenesis. The preventive and curative treatment of atelectasis and pneumonia with carbon dioxide inhalations will be briefly outlined.

I. DATA—TECHNIQUE—THEORY

In previous papers we presented experimental and clinical data upon which we based our conception that massive, lobar and lobular atelectasis have a common pathogenesis with massive, lobar and lobular pneumonia and that they are produced by occlusion of a common, lobar or lobular bronchus with mucous exudate. They differ only as to the nature and virulence of the microorganisms present in the occluding exudate.

We came to this conclusion after a long investigation of atelectasis and pneumonia, experimentally produced by bronchoscopic methods; in this work we used for the first time so far as we know, serial roentgenograms to check up the progress and evolution of these diseases. We have thus been able to follow step by step their inception, development, complications and their termination. The roentgenographic findings were controlled by serial bronchoscopic examinations. We have thus been able to acquire first-hand information on these conditions by the combined use of roentgenographic and bronchoscopic procedures.

Our technique of production of bronchial obstruction and of pneumonia have been given in detail elsewhere. For obstructing the bronchi we used a special rubber balloon, introduced into the chosen bronchus by means of a Jackson bronchoscope; the balloon once in place was inflated with a saturated solution of sodium bromide in order to render it visible in roentgenograms and then left in place. A complete bronchial obstruction was thus produced which could be interrupted at will, either completely by extraction of the balloon or gradually by allowing a slow and gradual deflation of the obstructing balloon.

For the production of experimental pneumonia we used an eighteen hour culture of pneumococcus Type I, in broth, concentrated ten times by centrifugation; 1–2 c.c. of the concentrated culture was insufflated through the bronchoscope by means of an atomizer, into the chosen bronchus.

Dogs were used throughout in our experiments. These animals are very resistant to the pneumococcus so that generally large doses of pneumococcus culture are necessary; most often pneumonia kills the animals in

twenty-four to seventy-two hours. But, on the other hand, dogs have a large trachea and bronchi, which facilitates bronchoscopic work, and an elastic mediastinal membrane which offers no resistance to the displacement of the mediastinal organs. We wish to give a word of warning here against an error easily committed: As the roentgenographic diagnosis and the follow up of atelectasis and pneumonia are based upon the degree of displacement of the mediastinum and the diaphragm, it is absolutely indispensable to obtain perfectly symmetrical pictures of the dog—in other words, the normal ray should pass through the mid-sternal line and the line of the spinal apophyses. Slight displacement of the animal gives erroneous roentgenograms. Because of the shape of the dog is this not an easy task. We therefore constructed a special stand (Fig. 1) which allows strictly symmetrical roentgenograms to be taken.

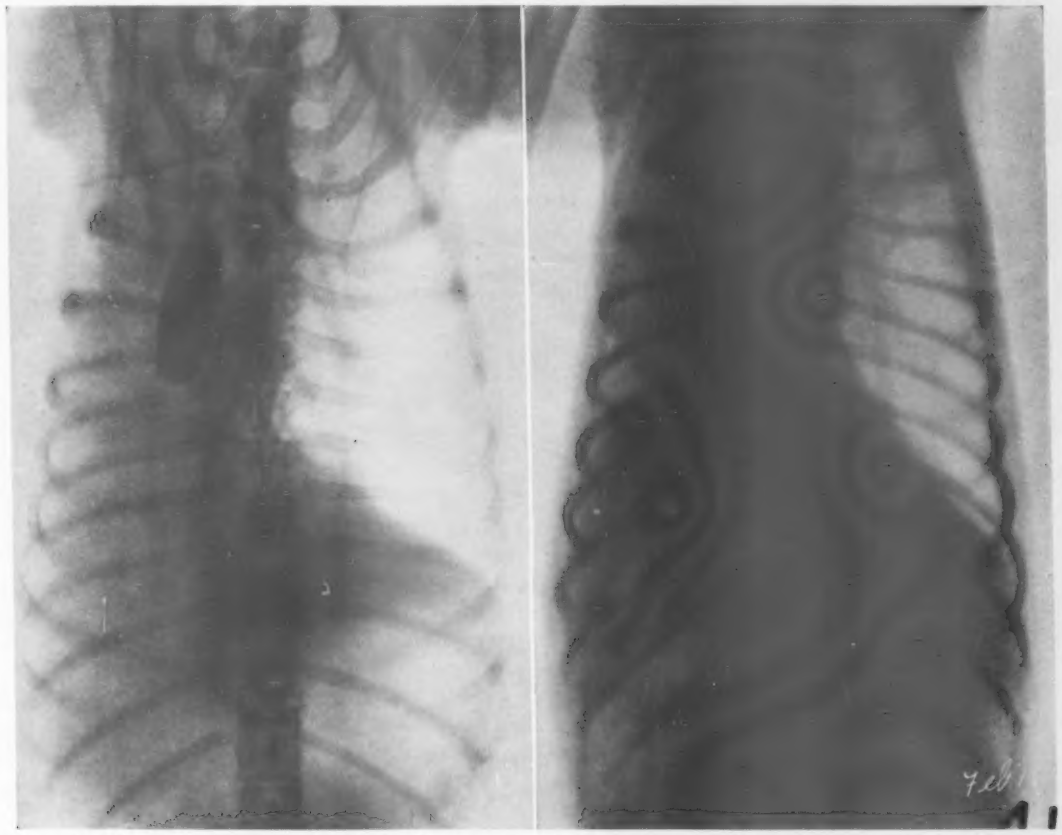


Fig. 2. A right massive atelectasis in the dog experimentally produced by obstruction of the right main bronchus with an "occluding balloon." Note the elevation of the right diaphragm, the displacement of the mediastinum to the right and the haziness of the right lung. The balloon is visible because it is filled with sodium bromide solution.
In all our roentgenograms the left side of the animal is on the right hand of the reader.

Fig. 3. An experimental pneumonia in the dog produced by insufflation into the right bronchus of 1 c.c. of concentrated broth culture of pneumococcus Type 1. Note the elevation of the right diaphragm, the dextrocardia and the haziness of the right lung.

The striking similarity of the roentgenograms obtained in experimental obstructive atelectasis and experimental pneumonia is shown in Figures 2, 3, 4 and 5, representing right and left atelectasis and pneumococcic pneumonia.

When the balloon is extracted the aeration of the atelectatic lung is complete in a few hours (from six to twenty-four hours). In cases of slow deflation of the balloon because of slight leakage, aeration of the lung ensues and the mediastinum and diaphragm gradually return to their normal position (Figs. 6 and 7). Exactly the same phenomena are observed in cases of spontaneous cure of experimental pneumonia in dogs (Figs. 8, 9, 10 and 11).

In one case of experimental pneumonia a spontaneous shifting from the right to left side of the pathological process was produced within twenty-four hours, exactly as in the migrating form of pneumonia in the human (Figs. 12 and 13). This case shows clearly the striking similarity of the roentgenographic findings in lobar pneumonia and massive atelectasis.

The above experimental findings are very similar to the roentgenographic findings in the human. In the discussion of our theory we will give clinical data on human atelectasis and lobar pneumonia proving this point. We place here parallel summaries for easier comparison of the respective symptoms and signs in these two diseases.

Massive Atelectasis	Lobar Pneumonia
Onset sudden, very shortly after operation, generally within 24 hours, dyspnea, thoracic pain, rise of temperature, pulse rapid. No rigor.	Onset sudden, generally after a very short incubation. Dyspnea, thoracic pain, rise of temperature, rapid pulse. Rigor.
Dullness, slightly tympanitic, decrease or absence of breath sounds. Later râles, or even bronchial breathing. Variations in dullness or sounds. Lack of toxic appearance.	Within the first hours—dullness, slightly tympanitic, decrease or absence of breath sounds. Later, bronchial breathing, bronchophony, crepitation. Toxic appearance.
Purulent, seldom bloody sputum.	Rusty or hemorrhagic sputum.
As a rule, presence of pneumococcus Group IV in the sputum.	Presence of pneumococcus of different types.
Ending by crisis or lysis. Crisis often after severe cough and expectoration of a great amount of sputum. Immediate relief after crisis.	Ending by crisis or lysis. Immediate relief after crisis.
Roentgen findings: Lobar distribution; one or more lobes involved. When atelectasis is unilobar, wedge-shaped shadow, whose base is on the parietal pleura, and whose apex is toward the hilar portion. Heart and trachea displaced to the affected side. Diaphragm elevated on the same side.	Roentgen findings: One or more lobes taken. When unilobar, wedge-shaped, shadow, whose base is on the parietal pleura and whose apex is toward hilar portion. Heart and trachea often displaced to the affected side, never to opposite. Diaphragm very often elevated on the affected side.
If the duration is short, return to normal roentgen aspect is very rapid. In delayed cases more time elapses between the clinical healing and the return to the normal roentgen aspect.	After crisis, gradual non-immediate return to the normal roentgen aspect.
Strict lobar distribution of the disease. Predilection for the inferior lobes and especially the right.	Strict lobar distribution of the disease. Predilection for the inferior lobes, especially the right.
Massive Atelectasis	Lobar Pneumonia
Affected lobe airless, consolidated, fleshy, sinking in water, dark blue color, friable, smaller in size than the healthy lung.	Affected lobe airless, consolidated, fleshy, liverlike, sinking in water. Smaller than the healthy lung.
Sometimes at post mortem larger bronchi found filled up with thick sputum.	Sometimes, especially in plastic forms, at post mortem, larger bronchi are found filled up with tenacious pneumococcic sputum.
Microscopically: Atelectasis plus more or less intra-alveolar exudate.	Microscopically: Atelectasis plus alveoli filled up with fibrinous exudate, etc.
If obstruction is prolonged, infectious complications, varying from diffuse pneumonitis to multiple abscesses occur. Generally very slight lesions of the parenchyma, rapid and integral repair of tissue.	In delayed forms, suppuration, abscess, or organization. As a rule, very slight lesions of the parenchyma. Rapid and integral repair of tissue.
Bacteriemia exceptional.	Bacteriemia frequent.

To the above summaries we should add the results obtained by the bronchoscopic examination by one of us (P. N. C.) in human cases of pneumonia. In every one of the 9 bronchoscoped cases the "bronchus corresponding to the consolidated area was occluded with viscid exudate."

It is obvious that the similarities in evolution, roentgenographic signs, pathology and even bronchoscopic findings in the two diseases cannot be considered as mere coincidences.

Upon these experimental and clinical data we have based the following theory for the production of atelectasis and pneumonia:

Postoperative atelectasis, which is only one form of atelectasis, occurs after operations generally upon the abdomen (particularly the upper abdomen) and exceptionally after operations upon the extremities, head and even oral cavity, and independently of the anesthesia used—inhalation, narcosis, spinal, regional or even local. It is due to accumulation, and stasis of bronchial secretion in the bronchi, because of inability of the lungs to expel it, and this because of splinting of the thorax by pain, posture and narcotics. Vital capacity, respiratory movements and especially cough are impaired for these reasons. The bronchial stasis will produce an irritation of the bronchial mucosa which will respond by increased mucous secretion. The bron-

chial exudate will be secondarily infected by microorganisms normally encountered in the upper part of the respiratory tract—

Fig. 4. Dog 251. Left massive atelectasis, experimentally produced by obstruction of left main bronchus.

among which penumococcus Group IV is the most important. A bronchitis will thus develop and the exudate will become more and more viscid because of the presence of the pneumococcus. If the means of defense of the lung—cough, respiratory movements and activity of ciliated epithelium—are greatly impaired, a bronchial obstruction may occur due to edema of the mucosa and the viscosity of the exudate. Gradual absorption of the alveolar air below the obstruction and atelectasis will follow. Conversely, as soon as the lung regains its means of defense the obstructing mucus will be expelled either suddenly and in a mass or slowly and gradually. In these cases only a slight cellulitis of the lung will develop due to the defensive and metabolic apparatus of the lung (Fried). But if, on the contrary, as in severe postoperative conditions, or in exhausted or bed-ridden patients, the mucus cannot be expelled and the obstruction is prolonged, then a cellulitis of variable severity will develop and give rise to pneumonitis, abscess or chronic bronchial stasis leading to bronchiectasis. The same conditions may ensue even in relatively resistant individuals if the virulence of the microorganisms infecting the exudate be high from the start.

In the other varieties of atelectasis, such as follow bronchitis in children or resulting from intrabronchial tumors, foreign bodies

Fig. 5. A left lobar pneumonia, twenty-two hours after insufflation of 14 c.c. of broth culture of pneumococcus into the left bronchus. (This amount of culture was centrifuged and concentrated to 1 c.c. before insufflation into the bronchus by the bronchoscope.)

completely occluding a bronchus or even from total extrabronchial compressions of a bronchus, the same sequence of symptoms has been repeatedly noticed.

In lobar as well as in postoperative pneumonia the same pathogenesis is found. In the course of a more or less severe pneumonic bronchitis, bronchial occlusion may occur. If this happens, the corresponding portion of the lung will not only be shut off from ventilation, but its normal drainage will be interrupted by an obstructing mucous mass infected with various microorganisms, especially the pneumococcus. In addition to the atelectasis a severe cellulitis will develop, rapidly spreading from the hilus to the periphery, and general toxic symptoms will appear here as for infection in closed spaces anywhere in the organism. General symptoms will be relieved as soon as drainage and relief

of tension are insured, whereas the local lesion will require more time to be repaired. As soon as the exudate occluding the bronchi is autolysed (under the action of the proteolytic ferments excreted by the white cells gradually overcoming the antitryptic properties of the serum) and coughed out or absorbed, the lung drains, the general symptoms are rapidly relieved, and cure follows by crisis or lysis. Thus several features in lobar pneumonia, heretofore inexplicable, find a simple and easy explanation. The lobar distribution of pneumococcic pneumonia is explained by the more viscid exudate caused by these microbes which renders possible the obstruction of a major bronchus. The crisis or lysis occurring between the fifth and eleventh day is explained by the fact that this is about the time required for the completion of the proteolysis of the fibrinous exudate. The relief of the general symptoms, though the local condition of the lung seems unchanged, is accounted for by what happens elsewhere in the organism under similar conditions (opening and drainage of a purulent collection); furthermore the abortive forms are easily understood as due to an early expulsion of the occluding exudate, whereas in the prolonged forms with delayed resolution, infectious and septic complications will occur (Pickhardt).

FIG. 6. A right atelectasis of the middle and lower lobes in a dog, experimentally produced by occlusion of the right bronchus with a balloon. The balloon is outlined with arrows.

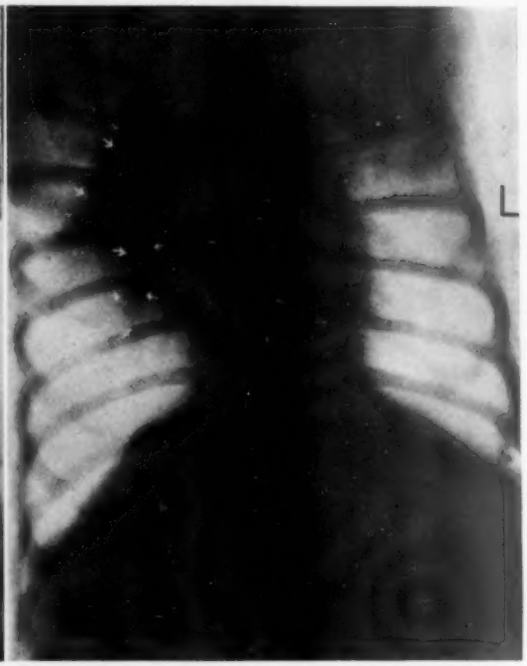


FIG. 7. Same animal as in Figure 6. By the fifth day after obstruction of the right lung the balloon has become deflated as the arrows outlining it show. The right lung is almost entirely aerated with the exception of a small part of the middle lobe. The heart is back to the left and the right diaphragm again at normal height.

Exactly as in atelectasis, the size of the bronchus obstructed varies with the viscosity of the exudate and the degree of edema of the mucosa, so that massive, lobar or lobular atelectasis or pneumonia may result; the microbes which produce less viscid exudate (*B. influenzae*, staphylococcus, streptococcus) are more apt to produce the latter form.

This theory puts lobar pneumonia in the same class with other infectious processes occurring in closed and undrained spaces. It throws a new light upon its pathogenesis and opens, as we shall see, a new horizon in its treatment. We think that this line of reasoning justifies the prediction of W. Pasteur who in 1910 wrote: "I feel sure

that when the true history of post-operative lung complications comes to be written, active collapse will occupy an important

taneously and did not use roentgenographic controls in their investigation.

No basic objections have thus far been

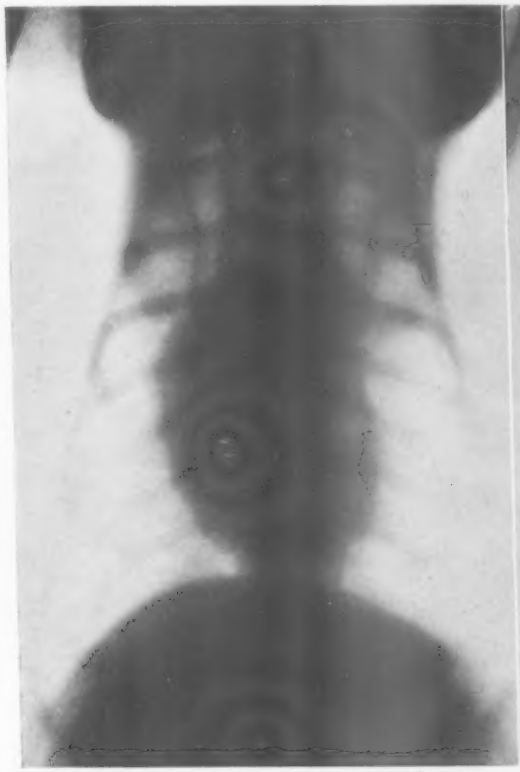


Fig. 8. Normal chest. Pneumococcus culture was insufflated into the right bronchus after this roentgenogram was taken.

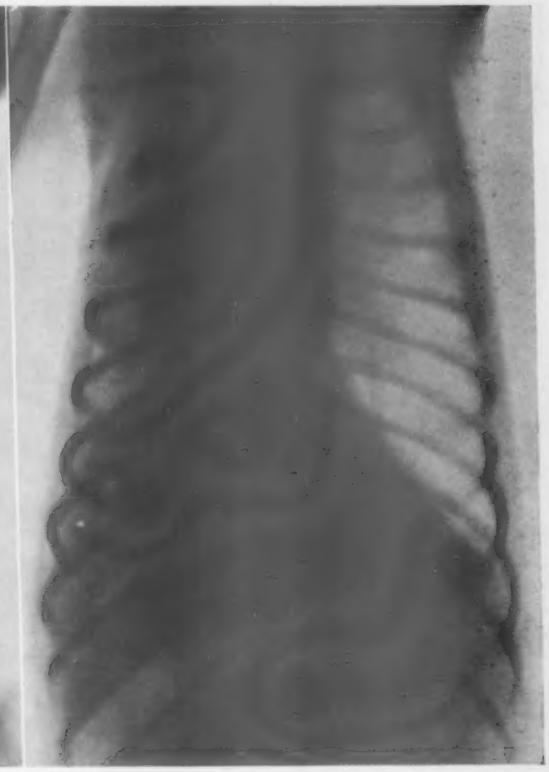


Fig. 9. Same animal as in Figure 8. Marked dextrocardia with a complete consolidation of the right lung has developed.

position among the determining causes," and Scott and Joelson (1927) who said, "An explanation of the origin of massive atelectasis will undoubtedly do far more than solve this clinical mystery, since it may prove to be a most important step in reducing the incidence of these fatal post-operative complications now classified as pneumonia." "The mere presence of pneumococci in the bronchi is not sufficient," says Meltzer, "for producing a pneumococcus infection," but if a previous cold furnishes the mucous secretion "which might occlude several small bronchi" the ground is prepared for pneumonia.

It is obvious that these authors came very close to the solution of the problem. If they did not grasp the true relation between atelectasis and pneumonia it is because they did not study both simul-

advanced against this theory, though when first presented it was characterized as far-fetched. We deem it opportune to present all possible objections and to discuss them in an impartial way. A theory is correct, we believe, only when it fits every particular case and is contradicted by none.

Objections to the Theory and Discussion.

The following objections may be raised against the theory developed above:

1. The frequent absence of bronchial obstruction at autopsies in atelectasis and in lobar pneumonia.

2. The frequent absence in lobar pneumonia of displacement of the trachea and heart to the affected side and elevation of the homolateral diaphragm.

3. The absence in lobar pneumonia of the element of "atelectatic collapse

of the lung," the affected lobes in pneumonia being clinically considered larger than the healthy ones.

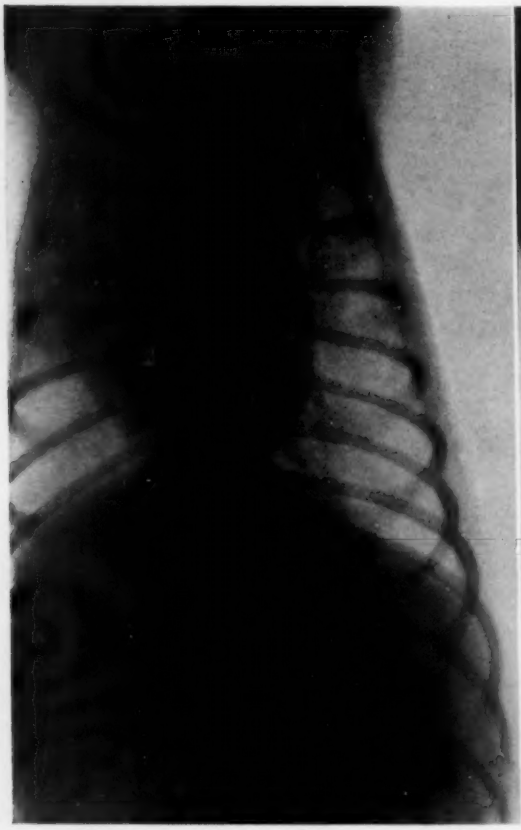


FIG. 10. The following day the chest was considerably clearer, and the heart resuming its normal position. Animal coughing considerably.

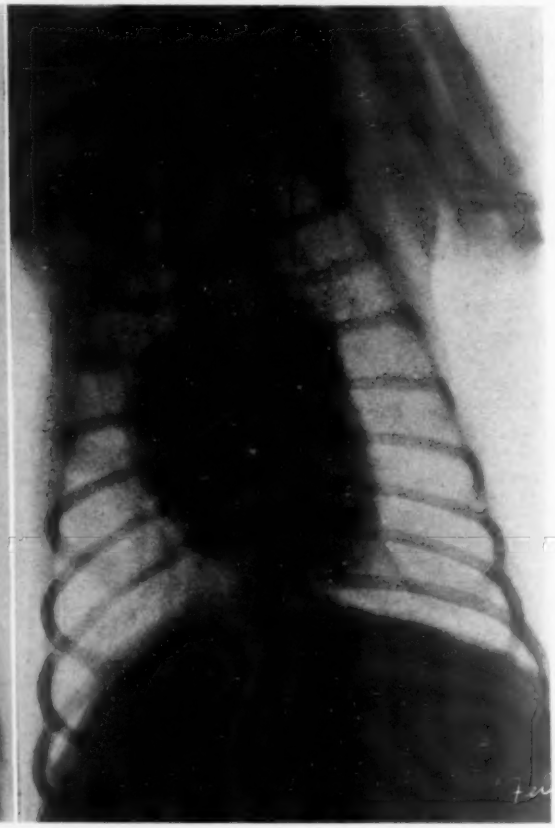


FIG. 11. The next day the chest was practically normal.

4. The great difference in toxicity and prognosis between the two diseases

5. The frequent absence in pneumonia of a preceding bronchitis.

6. The frequent difference in physical findings between the two diseases; absence of breath sounds in apneumatosis as against bronchial breathing, bronchophony and crepitant râles in pneumonia.

7. That pneumonia in the dog is different from pneumonia in the human so that we cannot draw conclusions about one disease from the other.

We shall answer every one of these objections.

1. The frequent absence of bronchial obstruction in atelectasis and lobar pneumonia at autopsy.

Nobody denies the fact that complete bronchial obstruction of whatever origin is followed by absorption of the alveolar air in the corresponding area of the lung and that atelectasis or apneumatosis ensues. However many of the investigators on atelectasis express the opinion that atelectasis is not always due to bronchial obstruction. W. Pasteur considered that the cause was paralysis of the diaphragm; Bradford believed "immobility and retraction of the chest wall . . . ; insufficient expansion of the chest whenever prolonged is capable of causing collapse." Both authors considered that "obstruction of the main bronchi may be excluded as a common or probable cause of the condition." Soltau, Soltau and Alexander, and Watson and Meighan, conceive of a possible reflex paralysis of the diaphragm; Ball considers an inflammatory fixation of the diaphragm and L. R. Sante an immobilization of the respiratory muscles as a defense reaction

or paralysis from toxic neuritis. Other authors reject the above "muscular theories" and consider the origin of atelectasis "the lumina of the finer passages are undergoing variations in size resulting from alteration of bronchomotor or vaso-

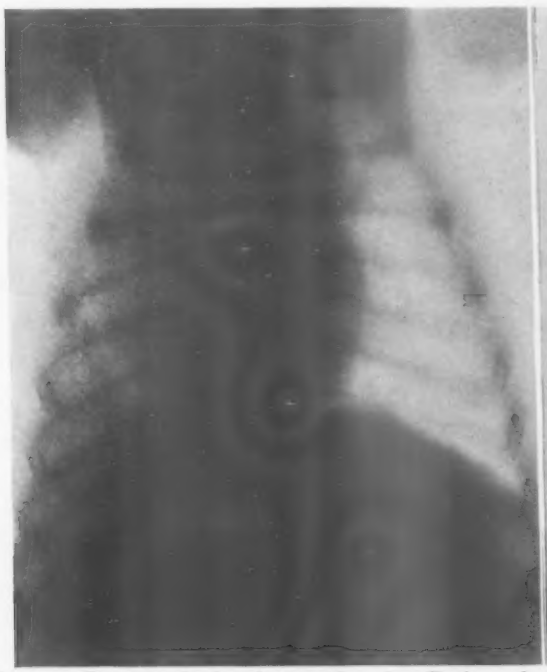


Fig. 12. Dog c 16 nine hours after insufflation of pneumococcus culture into the right main bronchus. The animal was allowed to lie on its left side over night.

Fig. 13. Dog c 16 the next morning. A spontaneous shifting of the pneumonia to the left side has occurred.

exclusively pulmonary. They admit that bronchial obstruction may occur in some phase of atelectasis but that the real determining cause is not bronchial obstruction but some kind of reflex. It is interesting to note that none of these authors gives an exact and precise description of the reflex involved or of the nature of the stimulus itself. The reflexes which have been considered in the pathogenesis of atelectasis are:

(1) *Bronchoconstrictor Reflex.* Churchill considered that bronchoconstriction could produce atelectasis when accompanied by shortened inspiration and prolonged expiration, as happened in the experimental work of Dixon and Brodie. Scott says, "We are justified in concluding that there is some reflex mechanism which produces atelectasis either directly or indirectly by secretion and obstruction." Scott and Joelson consider atelectasis as generally bilateral. "In both lungs," they say, motor tonus." But they add, "the initial reflex is possibly vasodilator in character and the most striking feature is an extreme pulmonary congestion, almost an angiomatous condition." L. Sante (1927) thinks that "some infection or insult to the region of the vagus supply produces a reflex on the bronchioli permitting their temporary collapse." Lee (1924) suggests as a possible cause, besides bronchial obstruction, "some paralysis or bronchial spasm due to a reflex irritation from other parts in the body."

(2) *Vasomotor Reflex.* Gwyn in 1923 suggested circulatory reflex disturbances. Scott and Cutler believed that "the process is initiated by a nervous reflex probably largely vasomotor which results in a narrowing of the peripheral bronchioles by venous engorgement, etc." Fontaine, and Lenormant and Iselin (1928) say, "If the direct irritation of the nervous fibers be responsible for massive atelectasis it must be through bronchospasm or

reflex vasomotor influence." Rouillard (1929) considers as a possible cause "reflex motor and vasomotor disturbances."

FIG. 14. A classic massive atelectasis of the right lung. Heart and trachea displaced to the right.

H. Santee, and Bergamini and Shephard, reported two puzzling cases in which atelectasis was produced on the operating table and rapidly killed the patients. "No obstruction of the bronchi was found at autopsy, but there was a uniform dilation of the capillaries, arterioles and vessels which strongly suggested the probability of a vasomotor disturbance;" and they ask: "May not this be a condition identical with or closely akin to angioneurotic edema?" Fontaine and Hermann concede the possibility of a "reflex production of atelectasis," though in only one of ten dogs in which they extirpated all of the intrinsic nerves to a lung was atelectasis produced on the third day, and this in the denervated lung.

Besides these theories on the pathogenesis of postoperative atelectasis, bronchopneumonia and lobar pneumonia, Lichtenberg, Kelling, Bibergeil, de Quervain, Cutler and Morton, Cutler and Hunt and others consider that minor embolisms of the lungs are a frequent cause of these complications. Cutler and his collaborators go even further and consider that embolism is the almost exclusive cause of them. They mention the results obtained by Sabin who showed the ease with which lymphatic, as well as venous channels may carry sepsis or emboli from the upper abdomen to the lungs. They conclude that almost every one of the postoperative pulmonary com-

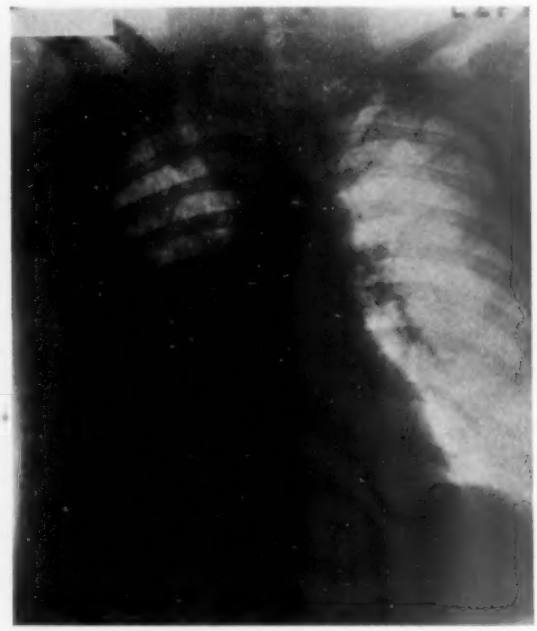


FIG. 15. Roentgenogram of a thirty-six hour old pneumonic process. Note the haziness of right middle and lower lobes, the deviation of the trachea and heart to the right and elevation of the right diaphragm (New York Hospital).

plications is due to "minor emboli" in the lungs.

We shall now answer these objections.

The "diaphragmatic" or "respiratory muscular origin" of atelectasis cannot be sustained today. Thousands of phrenicotomies, clinical and experimental (Lemon, Elliott and Dingley, Crymble, Coryllos and Birnbaum), have been performed and never has a single secondary case of atelectasis been reported. Jackson showed that in diphtheria atelectasis is not due to paralysis of the diaphragm but to bronchial obstruction with diphtheritic membrane.

The idea of a bronchomotor reflex causing atelectasis has no experimental evidence in its support. On the contrary, each time organic reflex or allergic bronchoconstriction is produced it is followed by emphysema and not atelectasis. Starling gave a clear explanation of this fact. In anaphylactic shock in the guinea pig where

an intense spastic contraction of the bronchial muscles occurs, a marked emphysema is the rule. Furthermore neither atropine existence of vasomotor nerves to the lung, but Krogh denies it. Cloetta and Anderes in a series of papers tried to demonstrate

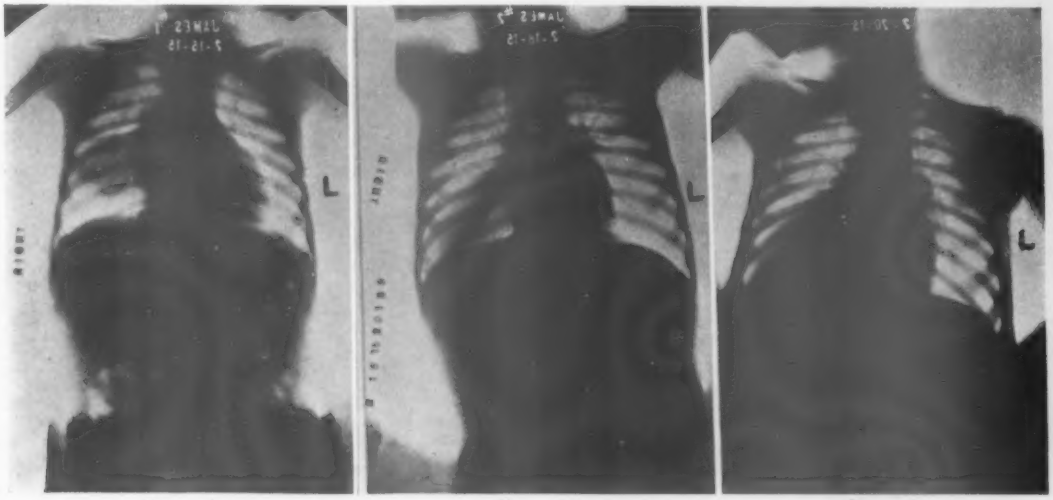


Fig. 16. Fig. 17. Fig. 18.

Fig. 16. A healing right middle lobe pneumonia in a boy aged ten (Feb. 15). (Courtesy of Dr. J. C. Roper, New York Hospital.)

Fig. 17. The same patient Feb. 18. The right middle lobe has cleared, but there is beginning involvement of the right lower lobe and the heart has shifted slightly to the right.

Fig. 18. The same patient Feb. 20. The right lower lobe pneumonia is very definite. Note the marked shifting of the heart to the right.

which paralyzes the bronchial muscles nor adrenalin which relieves the tonic contraction, has any affect upon atelectasis (Scott). Lastly, if atelectasis were due to bronchoconstriction, how could we explain its lobar distribution? Why, if such were its etiology, would not atelectasis be a diffuse process like emphysema, and not so accurately localized to a lobe or a part of a lobe?

The vasomotor theory (vasodilatation, angioneurotic edema) has no more clinical or experimental evidence than the bronchomotor in its support. Brodie and Dixon have never obtained any effect upon the pulmonary vessels by exciting the "vagi or the white rami communicantes from the upper thoracic spinal nerves or the sympathetic chain between the successive ganglia, or the annular loop of Vieussens or the inferior cervical ganglion." Stimulation of the nerve fibers at the root of the lung was equally ineffective. Starling remarks that "even if vasomotor nerves to the pulmonary vessels exist, they are of little importance." Weber upholds the the existence of vasomotors with a lung plethysmograph, but Bruns in a series of papers from 1909–1913 proved that Cloetta was mistaken in the interpretation of his experimental findings. Krogh in a remarkable paper discusses the conclusions of Weber and comes to the conclusion that the existence of vasomotors to the lung is extremely doubtful.

At any rate vasodilatation could produce atelectasis in only two ways—either by narrowing the lumina of the bronchioles or by mechanically expelling the alveolar air because of excessive dilatation of the alveolar capillaries. In the first case emphysema and not atelectasis would occur; besides, the lesion could not have a lobar distribution. In the second instance it would be impossible to explain the decrease in size of the atelectatic lung. Our experimental findings on the circulation in the atelectatic and pneumonic lungs show there is shrinkage and not a dilatation of the capillaries. How then are we going to explain the cases of Bergamini and Shephard and how their assertion that "ob-

struction cannot produce atelectasis in such a short time?" It is obvious that if the content of the lungs were air with 80 per cent nitrogen several hours would be required for complete absorption of the latter. But the lungs of these patients were filled up with a mixture of oxygen-nitrous oxide and ether, which as Teschendorf and Van Mechelen have proved is instantaneously absorbed by the blood of the lung capillaries. As for the experimental case of the denervated lung in the dog of Fontaine and Hermann, a careful reading of their paper convinces us that the animal had a pneumothorax and not an atelectasis.

We do not believe that minor embolism plays any important part in the pathogenesis of postoperative bronchitis, atelectasis and pneumonia. Physiologic, pathologic and clinical observations are against this theory. Karsner and Ash have proved that small emboli produce either no lesions in the lungs or else lesions presenting "the complete pathological picture of infarction." Wharton and Pierson insist on the point that clinically this form of pulmonary embolism (due to minor emboli) is clearly distinguished from the "postoperative inflammatory lesions" by its onset. It occurs late in convalescence, seldom as early as the fourth or fifth day. It is sudden and almost always accompanied by pleuritic pain below the scapula and slight elevation of temperature without any physical signs until the second or third day after the onset. At this time there develops the *characteristic friction rub and non-productive cough*. This is totally different from what happens in postoperative lung complications. Here there is generally a productive cough, the complications appear within twenty-four hours after operation, there is no pain and the physical signs are obvious. Whipple insists on the point that "during the first hours of initial high temperature the radiograms show a shadow in the lungs normally one or the other lower lobes;" furthermore there is always a productive cough. "Rusty or hemorrhagic sputum," says Whipple, "is exceedingly rare. The sputum as a rule is yellow mucous and usually shows pneumococcus group 4."

Elwyn commenting upon the embolic theory says, "There are none among our cases, which can definitely be considered embolic." On the contrary, he considers that postoperative pulmonary complications are especially frequent in the pres-

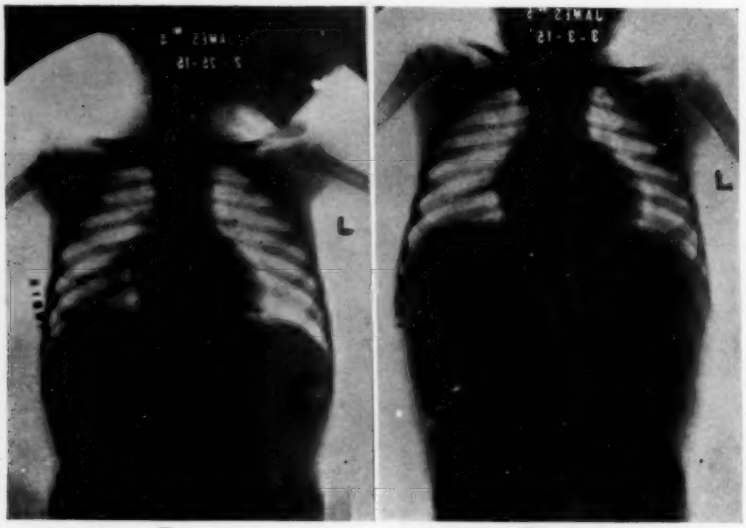


FIG. 19. FIG. 20.

FIG. 19. The same patient Feb. 25. The pneumonic process in the right lower lobe is healing. Note how the heart has shifted back to the left.

FIG. 20. The same patient March 3. The right lower lobe is practically healed and the heart definitely back on the left.

ence of a previous cold (25 per cent) and that they appear within twenty-four to forty-eight hours after operation, usu-

Fig. 21. A right massive lobar pneumonia, plate taken forty-eight hours after the chill. Note the similarity to a right massive atelectasis. (Courtesy of Dr. Friedman, Bellevue Hospital.)

ally as an atelectasis; but if this condition persists pneumonia may then develop. The same thing happens, he says, in case of hypostatic congestion in old people. "If the lungs do not expand after a length of time and there is present an infection in the bronchi, the infection has great chances to spread to the hypostatic lung and pneumonia results." Wharton and Pierson, and Hampton and Wharton reject the statements made by authors "who consider that the cause of any post-operative complication or almost any is due to *showers of miliary emboli*." Furthermore, why are these complications, if really due to embolism, so exceptional after operations upon the extremities or the head? Whipple reported 97 cases of pneumonia, and 88 of them occurred after laparotomies; in none of the autopsied cases was embolism found. Mandl gives a 2.7 per cent incidence after operation upon the extremities and a 10.5 per cent incidence after upper abdominal operations. The respective figures of Elwyn are 0.7 per cent and 13.8 per cent, and Cutler himself, who more particularly sponsors the embolic theory, gives 1.12 per cent and 8.0 per cent. Churchill reports a case of embolism complicated by atelec-

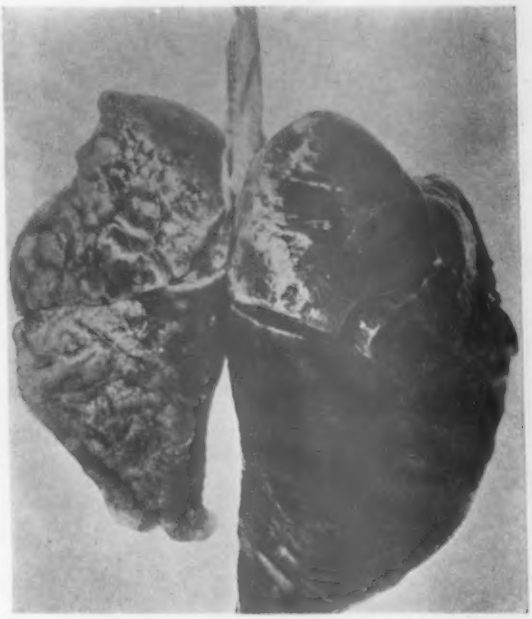


Fig. 22. Experimental pneumonia in the monkey. Posterior view. The right lung is involved and appears larger than the healthy (left) lung. Trachea not clamped. (After Blake and Cecil.)

tasis which shows that "even when atelectasis accidentally follows embolism the two conditions are distinct and can be readily recognized." Conversely, Jackson and Lee observed a case in which atelectasis was complicated by embolism, where the two lesions were easy to differentiate. In closing this discussion we shall quote Churchill who remarks, "We see no mechanism whereby an embolus can produce pulmonary collapse." Karsner and Ash have not been able to produce immediate deflation of the lung with small emboli; Elwyn also disregards embolism as "a factor in the production either of atelectasis or of postoperative pneumonia," and adds that "true pulmonary embolism should be diagnosed as such;" Wharton and Pierson concur in the point that "it is as a rule possible to establish a diagnosis between embolic lesions and inflammatory pneumonia."

We have discussed the embolic theory at length because we believe this theory should be definitely discarded in order

to clear the way for a better understanding of the etiology, pathogenesis, prevention and treatment of atelectasis and pneumonia.

Fig. 23. Specimen of a pneumonic lung in the dog, with the heart in place. The left lower lobe is pneumonic (p), and seems larger than the right lower lobe which is healthy (h). The trachea has not been clamped.

We think that we have answered all objections, and given the reasons for our conviction that none of the above factors plays a determining rôle in atelectasis.

The theory of bronchial obstruction, on the contrary, has a solid experimental and clinical backing. Mendelssohn (1845) and Traube (1846) produced atelectasis by occluding the bronchi with shot, paper and gum arabic paste. Gairdner (1850 to 1854) described the ball valve theory. Fuchs (1845) compared lobular pneumonia to the "apneumatosis lung of the foetus." Lichtheim gave the first experimental proof in 1879, in his remarkable experimental work in which he obstructed the bronchi of rabbits with laminaria sticks. But it was the invention of the bronchoscope by Killian in 1897, its marvelous improvement by Chevalier Jackson and his school and the close collaboration of the bronchoscopists with roentgenologists which have given us data on bronchial obstruction and its clinical manifestations. In a great number of publications, Jackson, Manges, Leopold, MacCallum, Lee and Tucker, Coryllos and Birnbaum, Harrington, Hearn and Clerf,

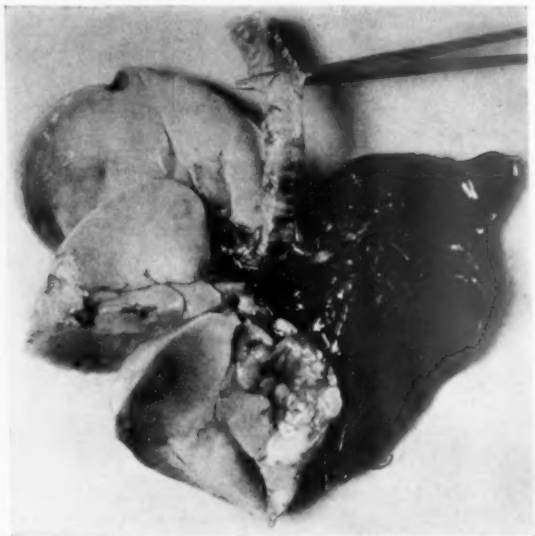


Fig. 24. Dog b 27. Left pneumonia. The trachea was clamped before the chest was opened. The left, consolidated, lung (dark in color) is smaller than the right (healthy) lung.

Mastics, Spittler and McNamee, and others, have shown the relation between bronchial obstruction and atelectasis and that only complete obstruction is followed by atelectasis whereas incomplete obstruction (check-valve of Jackson) produces emphysema (Manges, MacCallum). Furthermore, Sewall, Gammons, and others, showed that even tuberculosis is often complicated by large or small areas of collapse. Lee, Ravdin, Tucker and Pendergrass, in a recent paper (1928) gave a brilliant demonstration of the importance of bronchial obstruction in atelectasis. In a human case of typical postoperative atelectasis they aspirated by the bronchoscope a viscid bronchial exudate which they then introduced into the bronchus of a dog previously anesthetized with amytal (in order to suppress cough). The man was relieved of his atelectasis and the dog developed a typical atelectasis. Bowen in a recent (1929) and most complete article on atelectasis, comes to the conclusion that bronchial obstruction is the main cause of atelectasis.

The importance of bronchial obstruction

in the development of *lobar pneumonia* was shown by our bronchoscopic observations in human cases in which the

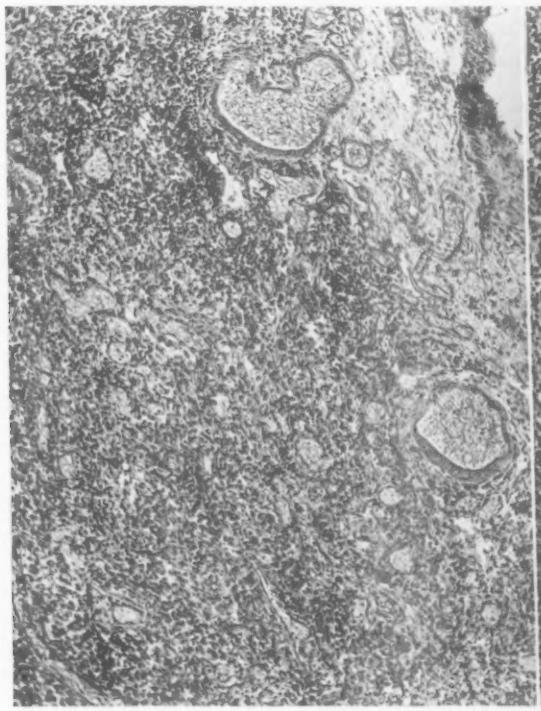


Fig. 25. Photomicrograph of fetal atelectatic lung.

Fig. 26. Photomicrograph of atelectatic lung, experimentally produced in the dog.

bronchus corresponding to the affected area was constantly found occluded with exudate.

We believe that complete bronchial obstruction is the only determining cause of atelectasis and pneumonia, other factors being only adjunct—or favoring causes.

2. The absence of displacement of the mediastinum in pneumonia.

First of all we wish to remark that in uncomplicated pneumonia displacement of the heart and trachea to the healthy side never occurs. If the classic opinion that the pneumonic lung is larger than the healthy one were correct, we should, as a rule, have a displacement of the mediastinum to the side opposite the lesion. Quite to the contrary, a great number of cases have been reported, particularly in children (Thoenes, St. Engel, Wallgren, Griffith) in which the heart was markedly displaced to the affected side. These cases were considered paradoxical and no explanation could be given. A more careful survey of roentgenograms in pneumonia—unfortunately not very frequently taken—shows very clearly: (1) the absence of displacement of the mediastinum to the opposite side; (2) a constant elevation of the diaphragm on the affected side, generally attributed to a temporary palsy of this muscle because of the inflammation of the pleura which covers it; (3) a frequent clear-cut displacement of the trachea and heart to the affected side. We give here six roentgenograms proving this fact. Figure 14 represents a case of atelectasis with which it will be interesting to compare Figure 15, a roentgenogram of a twenty-four hour lobar pneumonia of the right lower lobes. Figures 16, 17, 18, 19 and 20 are serial roentgenograms of pneumonia in a child showing very clearly that the displacement of the mediastinum and of the diaphragm follows the development of consolidation. We owe these roentgenograms to the kindness of Dr. J. C. Roper. The usual explanation

given for the elevation of the diaphragm (inflammatory paresis or paralysis) does not seem to us correct because the same

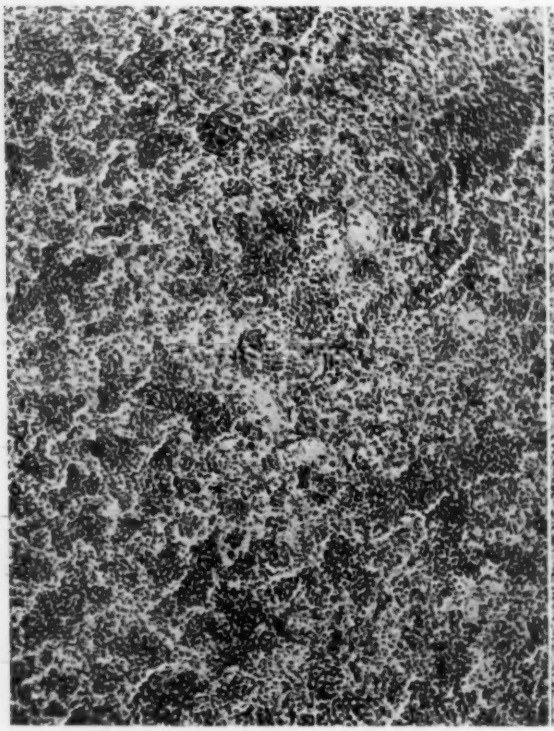


FIG. 27. Photomicrograph of an atelectatic lung in the dog which has gone on to an acute exudative lobar pneumonia because of prolonged mechanical obstruction of a bronchus.

FIG. 28. Photomicrograph of experimental pneumonic lung in the dog. Compare with Figure 29.

elevation is noticed in cases in which pneumonia is strictly limited to an upper lobe. It seems that there is an inverse relation between the degrees of displacement of the diaphragm and mediastinum apparently dependent upon the degree of freedom and mobility of the latter. If the mediastinum is not displaced as much as in atelectasis it is because of two reasons: first, in pneumonia there is besides the element of atelectasis, a cellulitis which lessens the degree of shrinkage of the affected lung; second, because in lobar pneumonia generally one or part of one lobe only is involved at the time, or lobes in both lungs are affected. It is obvious that displacement in these cases will be much less apparent than in massive unilateral atelectasis involving several or all of the lobes of one lung. *We thus came to make a statement that would seem in utter contradiction to the classic conception: In unilateral pneumonia the more extensive the involvement and the greater the number of lobes affected, the more marked will be the displacement of the mediastinum and the elevation of the homolateral diaphragm.* A proof of this is given by a roentgenogram of a massive lobar pneumonia (Fig. 21) which we owe to the kindness of Dr. L. J. Friedman, radiologist at Bellevue Hospital. It represents a medical pneumococcic pneumonia forty-eight hours after the chill. This brings us to the question relative to the size of the consolidated lung in lobar pneumonia. The classical conception of the size of the pneumonic lung is based upon an error. As we have shown in a previous paper, the classical opinion transmitted from textbook to textbook and from generation to generation that the pneumonic lung is larger than the healthy one (Fig. 22) is utterly incorrect. It is based on a misinterpretation of pathological findings. *We cannot evaluate the true respective sizes of the lobes of the*

lungs once they have been extracted from the thoracic cavity. There is an important factor, the action of which is suppressed Through the tracheal cannula and with the lung *in situ* or extracted from the thoracic cavity, air is insufflated under a

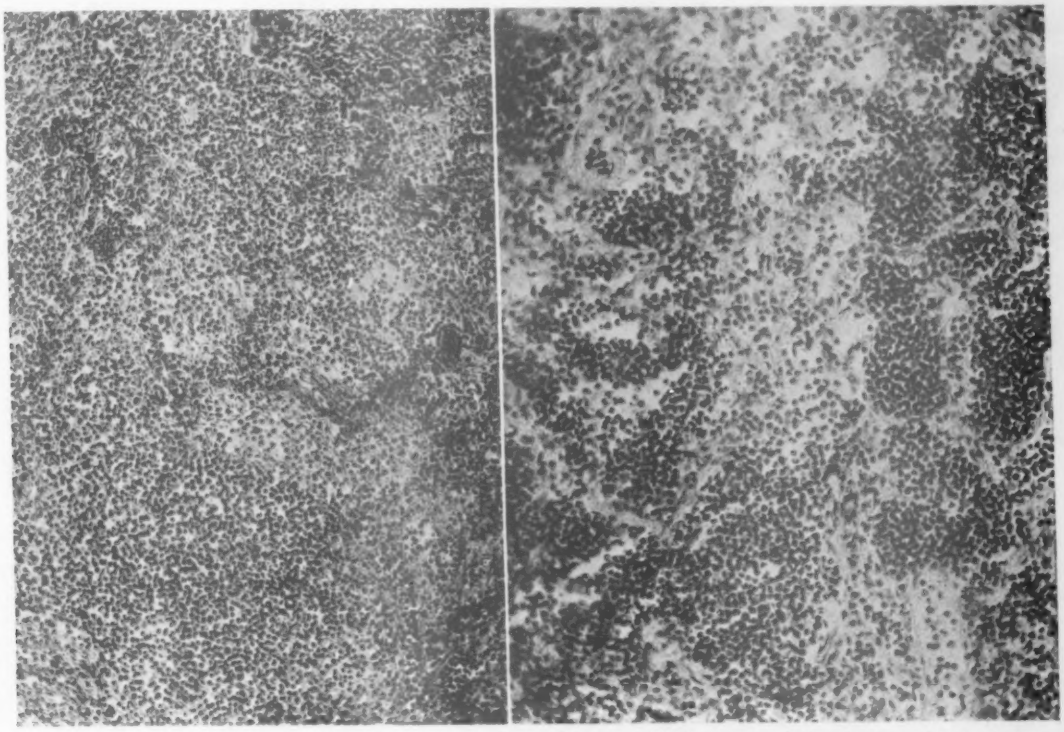


Fig. 29. Photomicrograph of pneumonic lung in the human. Compare with Figure 28.

Fig. 30. High-power photomicrograph of pneumonic lung in the dog, demonstrating diplococci in exudate.

with the opening of the chest and which, during life, regulates the size of the lungs; this is the *negative intrapleural pressure*. With the opening of the chest the lungs collapse; but in pneumonia the only lung which can collapse is the healthy one, whereas the consolidated one will remain unchanged in size. In order to estimate the true and not the apparent respective sizes of the healthy and consolidated lobes of the lung, it is necessary either to clamp the trachea before the chest is opened or, even better, to use the following more accurate method. A cannula of suitable caliber is introduced into the trachea and tightly tied within its lumen. This cannula is connected to a water manometer. The chest is opened and the positive pressure which is registered on the manometer recorded. This pressure measures the elastic recoil of the lung or what is the same, the intrapleural negative pressure. pressure equal to the one registered by the manometer. It would be better to enclose the lungs in an air-tight chamber from which air is sucked until the water manometer shows zero again. This procedure would restore the lung to its true size and show the affected lung smaller than the healthy one. This fact explains the absence of displacement of the mediastinum to the healthy side in pneumonia, its often noticed displacement to the affected side and the constant elevation of the diaphragm on the same side.

The figure given here (Fig. 23) of the lungs of experimental pneumonia with non-clamped trachea, and Figure 24 in which the trachea was clamped will present the evidence upon which our conception is based. This fact has been verified on human cadavers.

3. The third objection concerning the difference in toxicity between atelectasis

and pneumonia is easily answered. In atelectasis the infecting agent is usually pneumococcus Group IV, a saprophyte of the mouth and throat which is present in almost 80 per cent of perfectly healthy persons. This fact was shown by Louis Pasteur who first discovered the pneumococcus in the mouth of a child affected with rabies and called it "the microbe of saliva," by Sternberg who found it in his own saliva, by Netter, Talamon, and lately by Whipple and many other investigators. It is a pneumococcus of low virulence which gives an infection of low toxicity. On the contrary, in ordinary medical pneumonia (particularly in epidemics), we have to deal with pneumococci of much higher virulence and therefore with infections of much higher toxicity. Furthermore should the pneumococcus Group IV infecting an atelectasis become more virulent than usual the patient would present toxic symptoms and then the diagnosis of postoperative pneumonia would be made rather than of atelectasis.

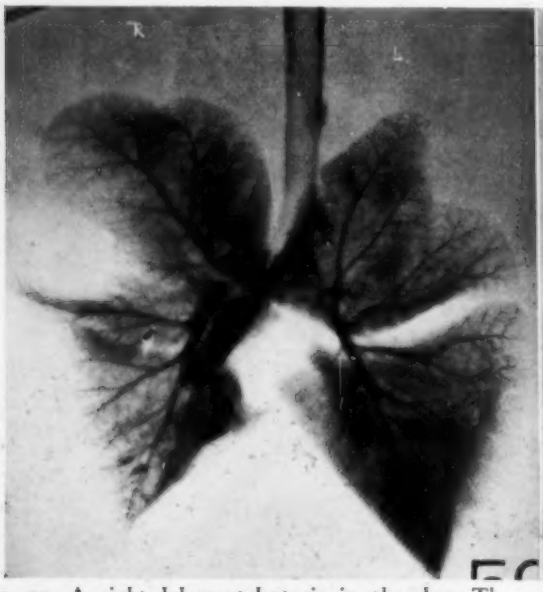


FIG. 31. A right lobar atelectasis in the dog. The occluding balloon is seen because it is filled with sodium bromide solution. The living animal was injected with lipiodol by way of the jugular vein, and the lungs removed from the chest and this roentgenogram taken. The pulmonary arterial tree down to its finest ramifications is injected. By this means atelectatic and normal lungs cannot be distinguished.

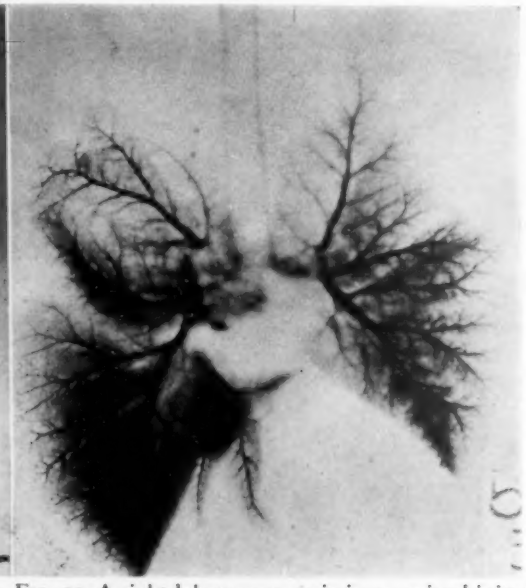


FIG. 32. A right lobar pneumonia in an animal injected with lipiodol. This roentgenogram of the removed lungs shows all lobes well injected.

The growth of pneumococci is favored in bronchial occlusion. As we have shown, the pneumococcus in vitro shows a marked increase in growth when the plates on which it is grown are kept under reduced oxygen tension. Whipple has compared postoperative pulmonary pneumonitis to the mild form of medical pneumonia known as "maladie de Woillez" in the French literature and well described clinically and pathologically by Carrière. It is interesting that in the description of the pathology of this pneumonitis one will recognize the pathology of atelectasis. "The involved lobe," says Carrière, "was heavier than the unaffected one, had a beefy feel, the cut section showed a reddish fluid and the alveoli were filled with exudate *containing no fibrin*, etc." Whipple believes that this type of medical pneumonia corresponds exactly to postoperative pneumonitis. The gap between atelectasis and medical pneumonia is thus spanned, the connecting link being postoperative pneumonitis. Only too often in progress notes of postoperative pulmonary complications have we found, before atelectasis was well known and understood, the following note of the

consulting internist: "Physical signs are those of postoperative pneumonia but the diagnosis cannot be made with certainty because of the absence of the toxic element."

4. Against the fourth objection, namely, the frequent absence of any premonitory bronchitis in lobar pneumonia, we have only to bring to mind that in atelectasis there are also no apparent premonitory signs. The disease appears to develop suddenly within twelve to twenty-four hours after operation, without any apparent previous cold, in perfectly healthy patients, and often after aseptic operations, especially on the abdomen. It is immaterial whether the operations were performed under spinal, regional or local anesthesia. However, we very often find a previous cold of greater or lesser severity in both atelectasis and pneumonia. Austrian goes even further and asserts that if we do not always find this previous bronchitis it is because we have not looked for it. The similarity is even greater in cases of lobar pneumonia in drunkards exposed to the cold during the winter months or in persons who have fallen into the water or after poisoning with carbon monoxide. Bowen remarks that "Nasal and pharyngeal catarrh and bronchitis are ever with us. Either latent or active, few people in the so-called temperate zones are wholly free from them. Even of those well-situated hygienically, the great majority will spend a major part of their lives in an atmosphere over-heated and over-dried. *The 'makings' of acute bronchitis are ever at hand needing only a temporary inhibition of the protective factors which have ordinarily prevented their activity.*"

5. As to the fifth objection, namely, the dissimilarity in roentgenographic and physical signs between atelectasis and pneumonia, we may state that the differences are only apparent. This question has been extensively dealt with in a previous paper. We shall only mention here that Weill and Mouriquand in studying 350 cases of pneumonia, report that: "The early shadow is usually triangular with its base always cortical, and we have never seen a shadow which could be considered entirely central." They insist upon the important fact that the shadow is "often present long before the signs of consolidation appear; what is more, in some cases these signs may never appear." In the discussion which followed the presentation of the present paper at the meeting of the Philadelphia Roentgen Ray Society Pancoast insisted on the same point. Mason, studying 37 cases of uncomplicated lobar pneumonia in children found that the shadows were "always triangular in shape with the base on some portion of the periphery of the lung." According to Tripier, the process of consolidation seems to begin in that portion of the lung which is "anatomically farthest from the hilus, that is to say that part of the lung that lies close to the pleura be it parietal, diaphragmatic, mediastinal or the pleura of an incisura." Holt and Howland concur in this opinion. Jaches found that "massive atelectasis causes practically the same density of a lobe

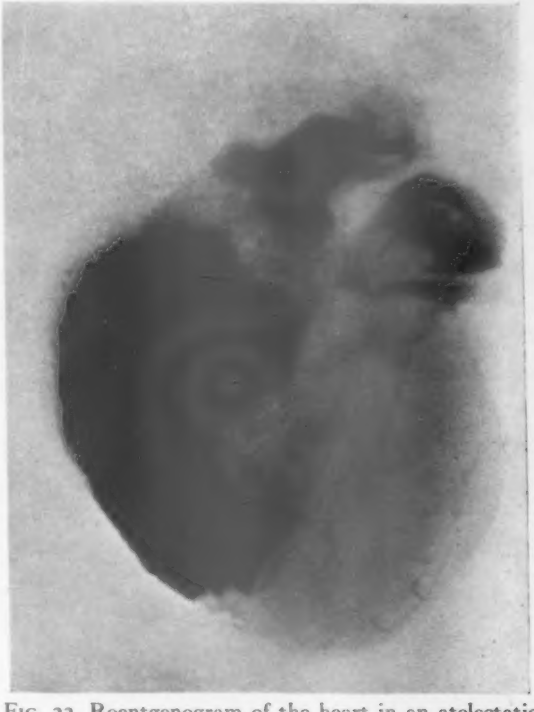


Fig. 33. Roentgenogram of the heart in an atelectatic dog injected with lipiodol by way of the jugular vein. None of the oil has apparently been able to pass through the lung capillaries to the left ventricle which is free of oil. Right heart is filled with oil.

as that seen in lobar pneumonia." On the other hand, the painstaking work of Cecil, Blake and their collaborators has established that pneumonia or "pneumococcic cellulitis," as they put it, spreads from the hilus to the periphery. How then can we explain the triangular shape of the shadow, its peripheral base and its apparent spreading *towards* the hilus as in atelectasis though the lesion in pneumonia starts *from* the hilus, if we do not admit the presence in pneumonia of two lesions simultaneously evolving—atelectasis and pneumococcic cellulitis?

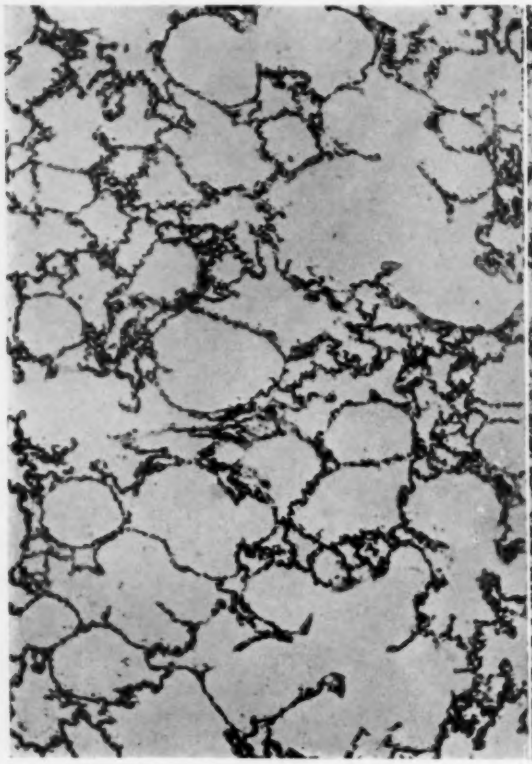


Fig. 34. Normal lung in an atelectatic animal injected with 20 per cent India ink in Ringer's solution by way of the jugular vein. The capillaries are well injected.

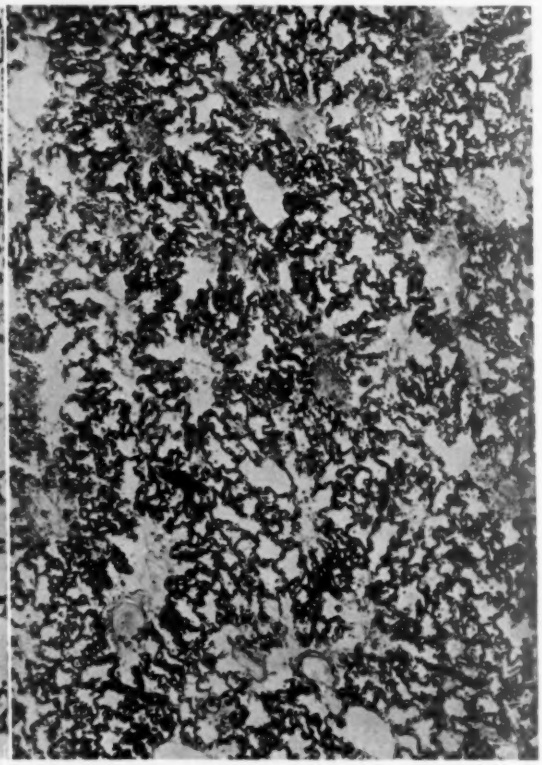


Fig. 35. Section of an early atelectasis in the same animal. The caliber of the capillaries is less and they are more tortuous. The alveoli are outlined by the capillaries and are distinctly smaller.

The physical signs corroborate this conception. In fact, in the early stages of pneumonia there are "dullness over the corresponding area with diminished breath sounds" (Whipple), "quiet suppressed breathing" (Osler), "suppression of breath sounds" (Austrian), "weakness of the breath sounds over the affected area" (Leslie and Alexander). All of these are given as the earliest physical signs in lobar pneumonia. All of them are characteristic of apneumatosis. In prolonged cases of atelectasis every kind of râle, including crepitation, bronchial breathing and bronchophony can be found. The case histories published on atelectasis or on postoperative pneumonias are extremely interesting. In the greater number of them it is impossible to state definitely whether they are cases of apneumatosis or of pneumonia. Besides, a number of cases have been reported of atelectasis complicating pneumonia (Gwyn), or conversely, of pneumonia complicating atelectasis (Elwyn). In concluding, we wish to quote Leopold who states that "the symptoms, pulmonary physical findings and leucocytosis may be regarded for clinical purposes so similar that on these findings a differential diagnosis between atelectasis and lobar pneumonia is impossible."

6. It has been objected that histologi-

cally apneumatosis differs from pneumonia and that pneumonia in the dog is different from that in the human. There is no doubt

These objections having been answered, we wish to present some of our recent findings in the investigation of atelectasis

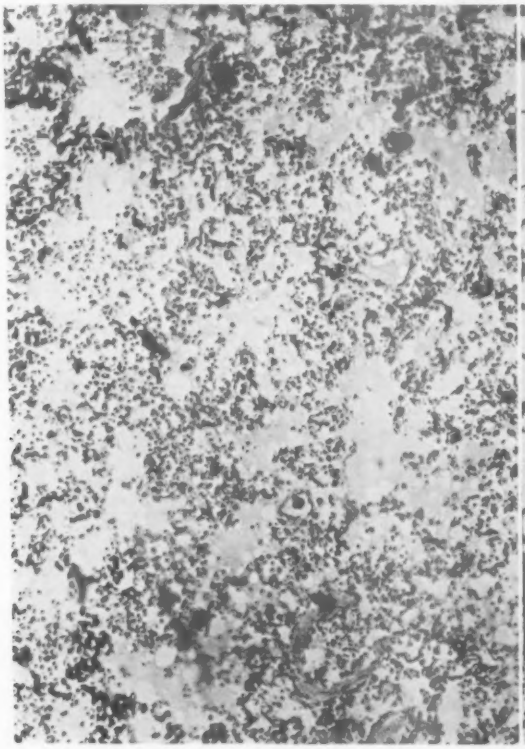


Fig. 36. An advanced atelectasis and markedly impaired circulation.

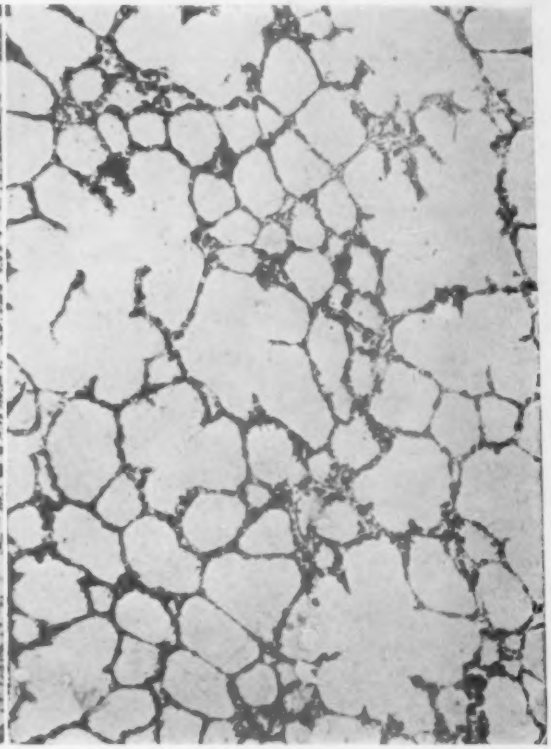


Fig. 37. Normal lung in a pneumonic dog.

that between the extreme forms of uncomplicated atelectasis and croupous pneumonia there are marked histological differences—for example, the absence in the exudate of fibrin and red cells in atelectasis, always present in pneumonia. But between atelectasis and a mild form of pneumonia or between a complicated atelectasis and postoperative or lobar pneumonia these differences fade and disappear. The comparison of a few photomicrographs given here shows this transition from fetal lung (Fig. 25) and atelectasis (Fig. 26) and to lobar pneumonia (Fig. 27). Figure 28 representing a section of pneumonic lung in the dog shows its great similarity to human pneumonia (Fig. 29). Dr. Symmers has seen some of our microscopic preparations of experimental pneumonia and considers them identical with human cases (Fig. 30).

and pneumonia which are further evidence in favor of our view. They are: (1) the identity of the changes in the capillary circulation in the affected lobes in both conditions; (2) similar disturbances in gaseous exchange; (3) similar reactions in both diseases when the animal is placed in an atmosphere containing 5 to 7 per cent of CO_2.

(1) *Circulatory Changes in the Atelectatic and Consolidated Lung.** We shall not discuss the different theories of circulation in the compressed (pneumothorax, pleurisy), apneumatic (atelectatic) or consolidated (pneumonic) lung. Suffice it to say that the greatest confusion still prevails on the subject. Lilienthal makes a sharp distinction between the compressed and

* These findings were extensively given in a paper read before the American Society of Thoracic Surgery, in April, 1929, at St. Louis, and will be published in the *Archives of Surgery*, January, 1930.

atelectatic lung. He believes that in the first condition circulation is decreased but that in the second it is increased.

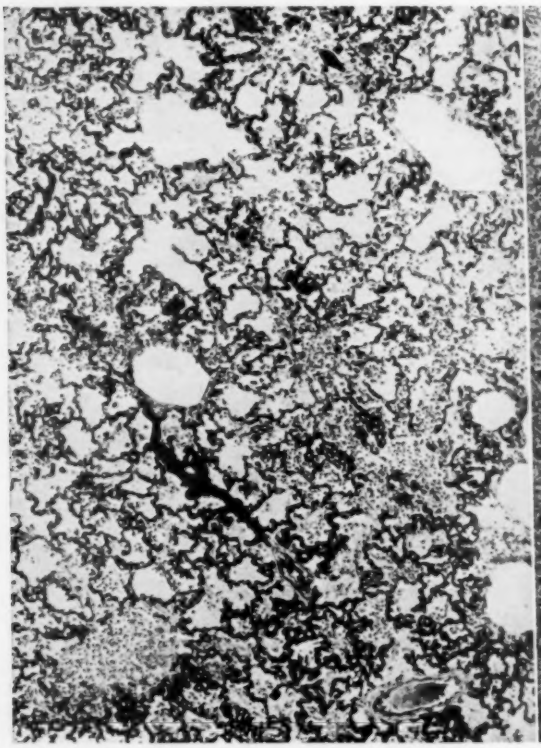


FIG. 38. A more advanced pneumonic process; beginning exudate. Note the small size of the alveoli, the impairment of circulation and dilated pre-capillary arterioles.

Cloetta and Sauerbruch consider that in both circulation is increased. On the contrary, Weber, Bruns, Propping, Yates and Torek maintain that in both conditions the circulation is impaired.

For the consolidated (pneumonic) lung the consensus of opinion is in favor of an impaired circulation but there is a wide difference of opinion as to its cause. MacCallum, Mallory, Rindfleisch and Binger and their collaborators attribute it to the compression exerted upon the capillaries by the intra-alveolar exudate. Ribbert, Pratt, Gross, Kline and Winternitz reject this view and consider as the only cause of impairment of the circulation a diffuse thrombosis and embolism of the capillaries.

By modifying the methods of investigation and using a roentgenographic control we came to really unexpected conclusions which give a clear and simple solution of this problem which has not only a theoretic interest but also a real practical importance.

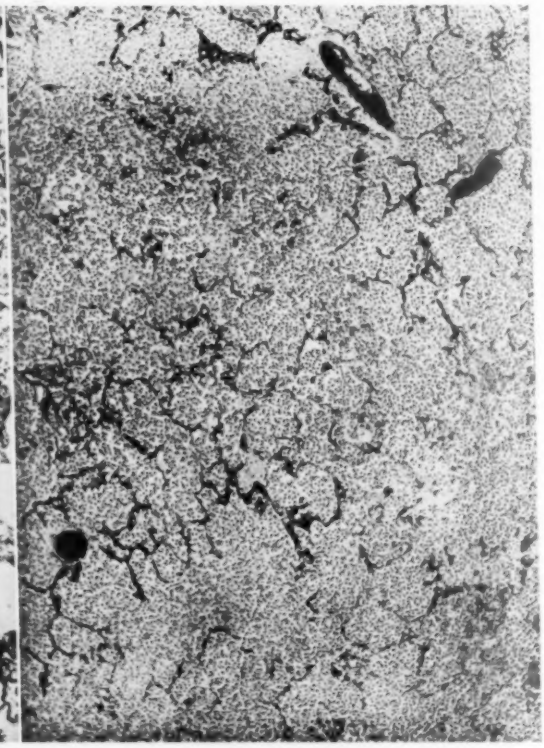


FIG. 39. A more advanced pneumonic process. Red hepatization.

The injection of iodized oil into the jugular vein of the living animal with a lung previously rendered atelectatic, has enabled us to visualize on roentgen films the branches of the pulmonary artery down to its smallest ramifications. This method has several advantages over the procedures used by Gross (bismuth oxychloride in gelatin) or Binger (powdered bismuth in gelatin). Iodized oil is not toxic so that it can be used in the living animal; it can be injected into the jugular vein without the aid of pressure so that it is the right ventricle which accomplishes its distribution through the pulmonary arterial tree, thus eliminating the error of pressure methods. Iodized oil at body temperature is sufficiently fluid to penetrate the smallest arterial branches. Roentgenograms of the lung obtained immediately after death of the animal show in an indisputable way that there is not

the slightest circulatory impairment in the arterial tree (Fig. 31).

The same method was applied to pneumonic lungs. We were very agreeably surprised to see, contrary to the opinion of most previous workers in this field, that there is no impairment of the circulation in the arterial system dependent upon the pulmonary artery. Figure 32 will show, as in the atelectatic lung, that the arterial tree is perfectly and equally well injected in the healthy and consolidated lobes, rendering any differentiation between them absolutely impossible. These pictures are totally different from the ones given by Binger and by Gross. This difference we believe due to the fact that these investigators injected post-mortem specimens and used gelatin as the vehicle for the radiopaque substances.

The iodized oil methods did not inform us, however, about the condition of the circulation in the capillaries. The fine arterioles are so clearly outlined that iodized oil could not have penetrated the alveolar capillaries; for if it had, a blurred view of the lung would have been obtained. Roentgenograms of the heart of our injected pneumonia and atelectatic animals corroborated this hypothesis by showing that whereas the right heart was filled with iodized oil not the slightest trace of it could be found in the left heart or viscera (Fig. 33). After several attempts with different substances, we succeeded in injecting the capillaries by using India ink in Ringer's solution in the living animal after having previously washed out the blood with Ringer's solution. Histological sections show the capillaries outlining the alveoli in black. This last feature possesses the important advantage that it enables us to follow in the different stages of atelectasis or pneumonia not only the condition of the circulation but also the changes in size and shape of the alveoli. We find that in both apneumatosis and pneumonia there is a gradual and progressive shrinkage of the alveoli going on in parallel with a gradual and progressive impairment in the circulation. Figure 34 represents a section of normal lung parenchyma in the dog. The capillaries are clearly visible filled with India ink and outlining the alveoli. Figure 35 shows the condition of the alveoli in a partially atelectatic portion, and Figure 36 shows a completely atelectatic portion of the same lung. Figure 37 shows a section of normal lung in a pneumonic dog. Figure 38 was prepared from an early pneumonia, and Figure 39 is a section from a portion of lung showing complete consolidation.

Besides the impairment in the capillary circulation in the advanced periods of atelectasis and pneumonia, we see very clearly that there is gradual shrinkage of the alveoli in pneumonia, absolutely comparable to that observed in atelectasis. Our theory in this way receives further confirmation. From this experimental investigation, we came to formulate the following principles:

In an apneumatic lung, independently of the mechanism of its production—compression, bronchial obstruction or consolidation—the pulmonary arterial system including the pre-capillary arterioles, is patent. But there is an impairment of the capillary circulation which is regulated by and is proportionate to the degree of alveolar collapse or shrinkage. Impairment of capillary circulation in the pneumonic lung is due neither to the compression of the capillaries by the intra-alveolar exudate, nor to thrombosis of the capillaries, but to the collapse of the alveoli. Besides, there is never a complete impairment of the capillary circulation and it is quickly relieved when the lung again becomes aerated and functioning; this explains the absence of trophic disturbances of the lung parenchyma in uncomplicated pneumonia and the rapid restoration of lung to normal.

(2) *The disturbances in the gaseous exchanges in the lung,* both in apneumatosis and pneumonia, show very suggestive similarities. At the beginning, in both diseases, there is besides O_2 unsaturation, an increase of CO_2 in the arterial blood. This is due to the persistence of circulation in the insufficiently ventilated lung, so that a part of the blood circulating through unaerated pulmonary channels is overcharged with CO_2 (Lundsgaard and Van Slyke) which it cannot give up and so pollutes the arterial blood on its return

to the left heart. When the circulation of the affected lung is almost completely suppressed, CO_2 instead of increasing uniformly shows a decrease. The same phenomena are observed in open pneumothorax, atelectasis by obstruction or ligation of the bronchi or in lobar pneumonia. The study of this fascinating problem will be reported in detail elsewhere.

(3) *Hyperventilation of the lungs by inhalation of a mixture of air and* CO_2 (*5–10 per cent*), has very peculiar effects upon atelectatic and pneumonic animals. An investigation carried on with Henderson and Haggard showed us: (1) that if we extract the obstructing balloon from dogs rendered atelectatic and put the animal in a chamber containing 5–10 per cent of CO_2 the atelectatic lung will be aerated much more rapidly than if the animal is left in ordinary air; (2) if, on the contrary, the animal is introduced into the CO_2 chamber immediately after the obstruction of a bronchus, the atelectasis will be completed more rapidly than if the animal is breathing in ordinary air. The explanation of the rapid aeration of the lung in the first case is due to the forceful inspiratory movements which dilate the thoracic cavity and force air into the atelectatic and recently obstructed lung. In the second case, the opposite occurs. The obstructed lung cannot expand because of the obstruction of its bronchus, but the healthy lung will not only be hyperventilated but it will become emphysematous. This is due to a certain degree of contraction of the bronchial muscles, CO_2 acting according to Starling somewhat similarly to stimulation of the vagi; thus the healthy lung will compress the obstructed lung on expiration, increasing the tension of the intra-alveolar air in the latter and facilitating its passage into the blood of the perialveolar capillaries.

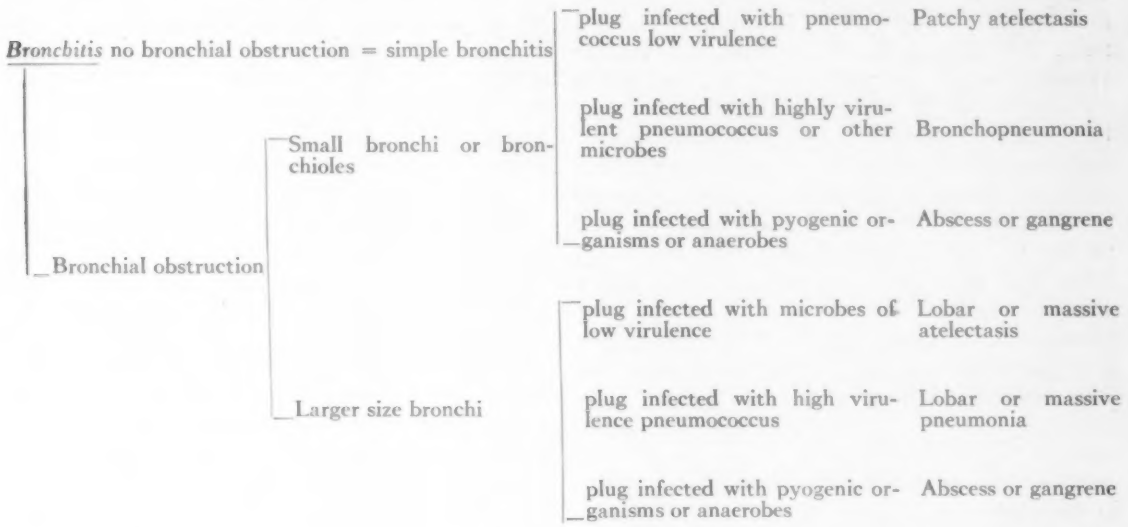
Dogs rendered pneumonic by intrabronchial insufflation of concentrated culture of pneumococcus according to our technique, present the following reactions when put in the CO_2 chamber: (1) if cough is induced, the animal expectorates viscid fluid and the lung clears up; (2) on the contrary, the roentgenograms may show an increase in the involved area. If, at that time the animal coughs, it may be able to empty its bronchi, relieve the obstruction, aerate the lung and recover. If it cannot cough because of an advanced toxic condition, it will die when left alone. At autopsy the lungs will appear filled up with a great amount of frothy and very slightly viscid fluid. On the contrary, the animal may recover if the fluid is aspirated by the bronchoscope.

We shall anticipate a bit by stating that in lobar pneumonia the action of CO_2 need not be simply mechanical as was stated in a previous paper with Henderson and Haggard. The same effects may be observed even when the animals are under general narcosis induced by amytal, when the CO_2 has no action upon the respiratory center as is clearly shown in respiratory graphs taken with the animal in the CO_2 chamber. In these cases no hyperpnea is induced. We believe that CO_2 can act by modifying the pH of the exudate to an acid point and thus interfere with the development of the pneumococcus (Dernby and Avery); such modification of the reaction speeds up the proteolysis of the fibrin (Lord, Ascoli, Bittorf and Opie) and considerably decreases the viscosity of the exudate. In other words, CO_2 seems to possess a peculiar and quite unexpected action upon the local pulmonary focus of infection. The discovery of these facts opens up new possibilities not only for prevention, but even for the treatment of pneumonia. This problem is still under investigation.

SUMMARY AND COMMENT

Lobar pneumonia is a pneumococcic atelectasis due to bronchial obstruction by mucous exudate infected with virulent pneumococci. Atelectasis or apneumatosis (generally but not always a postoperative pulmonary complication) is due to bronchial obstruction with mucous exudate usually infected with pneumococcus Group IV, an organism of low virulence. Postoperative pneumonia or pneumonitis is produced by the same mechanism as atelectasis and is due to the same infective organism, pneumococcus Group IV, which is, however, of higher virulence. The study of atelectasis gives us a better insight

into the relation between atelectasis and postoperative pneumonia, and in the broader sense between the three forms of the same pathologic process, namely, atelectasis, postoperative pneumonitis and lobar pneumonia. On such a basis, patchy atelectasis bears the same relation to bronchopneumonia that lobar atelectasis bears to lobar pneumonia or that massive atelectasis bears to massive pneumonia. Finally, we can state that the rôle and relative position of bronchitis in the evolution of the disease syndrome is represented by: bronchitis-atelectasis-pneumonia. This conception can be presented in the following schematic way:


Bronchitis no bronchial obstruction = simple bronchitis
Bronchial obstruction
Small bronchi or bronchioles
plug infected with pneumococcus low virulence
Patchy atelectasis
plug infected with highly virulent pneumococcus or other microbes
Bronchopneumonia
plug infected with pyogenic organisms or anaerobes
Abscess or gangrene
Larger size bronchi
plug infected with microbes of low virulence
Lobar or massive atelectasis
plug infected with high virulence pneumococcus
Lobar or massive pneumonia
plug infected with pyogenic organisms or anaerobes
Abscess or gangrene

From this scheme some idea may be acquired of the great importance in lung pathology of *bronchial obstruction*.

To the group of "bronchogenous lung diseases" there should be added for comparison the "hematogenous group." The experimental type of this group is given by the ligature of vessels—bronchial, pulmonary arteries and pulmonary veins, simultaneously or separately (Schlaepfer, Smirnow, Andrus, and others) or by the obstruction of capillaries (Binger et al.). Although there is a close interrelation between the disturbances of ventilation and circulation, we believe that it may be possible with more thorough experimental study and closer roentgenologic control of the clinical cases ("autopsy in vivo," as Rigler puts it) to render our clinical classifications clearer.

Be this as it may, there is no doubt in our minds that the "*bronchogenous group*" secondary to *bronchial obstruction*, complete or incomplete, constitutes a well-defined group. Some emphysematous and asthmatic conditions as well as chronic non-tuberculous bronchitides are interesting to study from the standpoint of incomplete bronchial obstruction and bronchial stasis. The perusal of papers such as Ochsner's recent article on unappreciated causes of chronic bronchitis, is very suggestive of the possibilities of an investigation in that direction. As far as bronchial obstruction is concerned, it seems surprising that this factor has been overlooked in the pathology of the lung. Here then is one more proof of the peculiarity of evolution of scientific knowledge—that very often the simplest and most basic roads are the last to be tread upon. It is general knowledge that interference with free drainage elsewhere in the organism produces more or less severe pathology. The lung can and should be likened to a gland the excretory duct of which leads to an infected medium, as in the salivary glands, pancreas, liver or sweat glands. As long as free drainage is ensured these glands, the parenchyma remains healthy; but if their ducts are obstructed infection will almost invariably ensue. Conversely,

re-establishment of drainage will relieve the complication. The same phenomena occur in the lung, and atelectasis (patchy, lobar or massive), postoperative pneumonitis, bronchopneumonia, lobar pneumonia, abscess and gangrene are complications which may follow bronchial obstruction. This conception throws a new light upon the pathology and symptomatology of lung diseases and brings together diseases heretofore considered unrelated. We hope that soon the internist, by modifying his ideas on lobar pneumonia, will depart from the precept of "absolutely immobilizing pneumonia cases." Instead he will perhaps try to provoke cough in them by changing their position in bed and by purposely rolling them from side to side. Moreover, he will give the roentgenologist an opportunity for a more thorough study of the disease and ask the collaboration of the bronchoscopist. In this way we consider that some progress may eventually be accomplished in our knowledge of the nature of lobar pneumonia and that new inroads may be made into the field of therapy based upon sound etiological principles. Lastly, the specific action of CO_2 may be of great help in the prevention and treatment of pneumococcic infections of the lung.

CONCLUSIONS

1. The importance of roentgenography in experimental investigations on atelectasis and pneumonia is shown.

2. Atelectasis, postoperative pneumonitis, lobar pneumonia (in their lobular, lobar or massive varieties) are shown to be produced by the same mechanism. The possible objections to this theory have been discussed.

3. The identity in pathogenesis of these morbid conditions of the lung is proved by the gross and microscopic appearances, their bacteriology, their circulatory disturbances, their evolution and the modifications in the pulmonary gaseous exchanges occurring in them.

4. Between them there are, in degree only, differences in local and general symptoms, roentgenographic signs and bronchoscopic findings. Lobar pneumonia is a local pulmonary infection with general manifestations. The management of the local infection is the most important part of the treatment.

5. They are all due to a factor of great importance—*bronchial obstruction*. Any interference with the free drainage of the bronchial tree will cause lesions the nature, extent, importance and evolution of which will depend upon the degree and duration of the obstruction and nature and virulence of the microbes present.

6. The rational treatment of these conditions should be based upon their etiology and, as in every other obstructive lesion in the organism, should aim to relieve the obstruction and re-establish free drainage of the bronchial tree.

7. Lobar pneumonia is a pneumococcic bronchial obstruction, with a combined atelectasis and pneumococcic cellulitis of the corresponding pulmonary area. Treatment should be directed not only against the bacteriemia but chiefly against the local or pulmonary lesion.

8. Carbon dioxide inhalation in 5 to 10 per cent concentration seems to possess a specific action against pneumococcic pulmonary infections and according to experimental and clinical data, could be used both as a preventive and curative agent.

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ROENTGENOLOGIC STUDIES OF MASTOID IN INFANTS

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THE American literature contains very little information relative to the value of roentgen-ray examination of the mastoid in young children. Although the otologists have written little on the subject, Stewart,[14] in 1913, described well-formed mastoids demonstrated roentgenographically in children two years of age, and Gerber[5] corroborated his statements in 1919. In 1923 Evans[4] published a résumé of his roentgen-ray findings in 46 children less than five years of age. Seven babies in this series were less than one year old and the author was enthusiastic over the valuable information obtained. Not all roentgenologists are in strict agreement, however, since Law[8] states, "Except in very unusual cases the mastoid process does not show cellular development before three years of age, and usually not until about the fifth year," and Goldstein[6] says, "The mastoid process contains no air cells at birth, but toward puberty the process becomes pneumatic." In 1909, when roentgen technique was far from what it is today, Lange[7] wrote: "Upon the mastoid skiagrams of children under ten years of age the mastoid appears entirely spongy or diploetic, there are no visible cells and the tip is undeveloped."

When Marriott[12] read his paper in 1925 dealing with the relation of nutritional diseases in infants to mastoid infection, an effort was made in our laboratories to obtain satisfactory films of the mastoids of babies. The difficulty of obtaining a reliable technique was the first stumbling block, and while our method is far from perfect at the present time, most of the films obtained reveal worthwhile information. After trying numerous mechanical devices it was finally thought best to revert to force. Consequently three assistants are used to hold the baby which is placed face downward on a plain table. One nurse holds the child's wrists straight to its sides and places the right elbow across its buttocks. A second assistant places the right hand on the feet and the left hand on the backs of the knees thereby keeping the legs straight, and a third helper sits on a low stool at the end of the table and grasps the baby's head between her extended fingers thereby holding it in the proper position. The ears must be doubled forward to obtain good detail in the postauricular region and it is our custom to strap each auricle down snugly against the cheek with adhesive plaster before beginning the examination. An 8″ × 10″ cassette is placed flat on the table and both mastoids are made on the same film using the Law technique. The angle towards the face is obtained by placing the baby's cheek flat on the cassette and the tube is then tilted 15° towards the feet. A long slender cone is utilized and some practice is needed in placing it squarely over the center of the mastoid. The baby struggles and cries continuously as a rule, and short exposures are necessary. Our technique consists of ⅛ second exposures with a 3 inch parallel gap and 80 ma. passing through the tube. If each exposure is made during a long expiratory cry the results are usually very good. It is advisable to have the assistant who holds the head wear protective gloves if she is to act in this capacity very frequently. As with all other forms of mastoid work, both exposures must be made in the same position and with identically the same exposure times if they are to be compared afterward. The whole procedure is far from easy and requires team work and patience, but remarkably good films can be obtained if one uses a little perseverence. Evans[4] gave his first cases an anesthetic to keep them still but states that he later adopted a "flash" technique similar to the one just described.

Having obtained good films of the region about the ear, we next became interested in determining the age at which the mas-

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

toid is sufficiently developed to make its study by the roentgen method worthwhile. Evans[4] concludes, "Pneumatic mastoid cavity in the region of the auditory canal and it would therefore seem doubtful that the antrum can be shown in young infants.

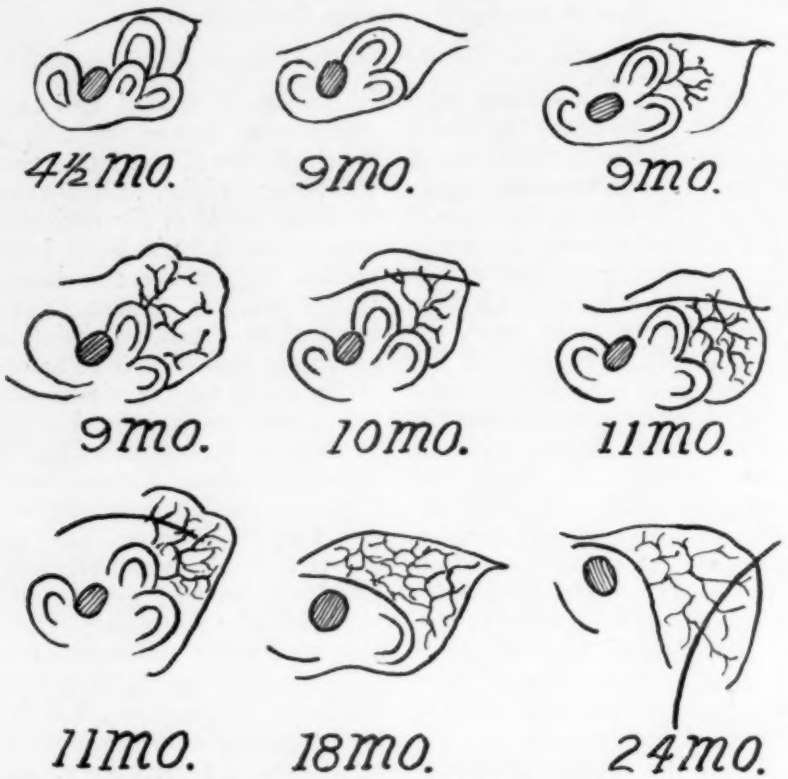

Fig. 1. Outline tracings made directly from actual mastoid films to show the variations in development of the structure.

structure is frequently observed before the end of the first year of life. The adult mastoid structure can be observed as early as the second year." Schwartz[13] in a recent article covers the literature on the development of this structure very well. He quotes Dench, Kopetsky, Politzer and Bacon as stating that at birth the mastoid consists of a single cell, the mastoid antrum, which according to Kopetsky has already reached its full size. Deaver describes the antrum as occupying a space about the size of a large pea. Bacon states that "from birth the mastoid process gradually develops by extending downward until at five years of age it is very similar to that of an adult." Zuckerkandl[15] feels that the process reaches its adult form in the third year of life.

In babies less than six months of age we were unable to demonstrate a definite In all probability this region is obliterated by the semicircular canals.

The drawings shown in Figure 1 were traced directly from actual films of a group of mastoids picked at random. On the average, the cavity appearing just posterior to the semicircular canals and below the tegmen tympani becomes large enough to be clearly outlined between the ages of six and seven months. From this age on pus or granulation tissue will produce a demonstrable difference in the shadow of the affected side when compared with the normal side. Real difficulties in interpretation arise when a pathological condition exists on both sides as is so often the case in infants. If a mastoid structure of a given type could always be expected at a certain age the problem would be easier. However, the three tracings made for babies nine months of age

illustrate the extremes of variation. In one actual cells have formed in a mastoid ¾ of an inch in diameter, while in another the entire cavity measures a scant ¼ of an inch in width. These findings indicate that mastoid development does not follow a fixed law but may assume different rates, some of which are quite rapid.

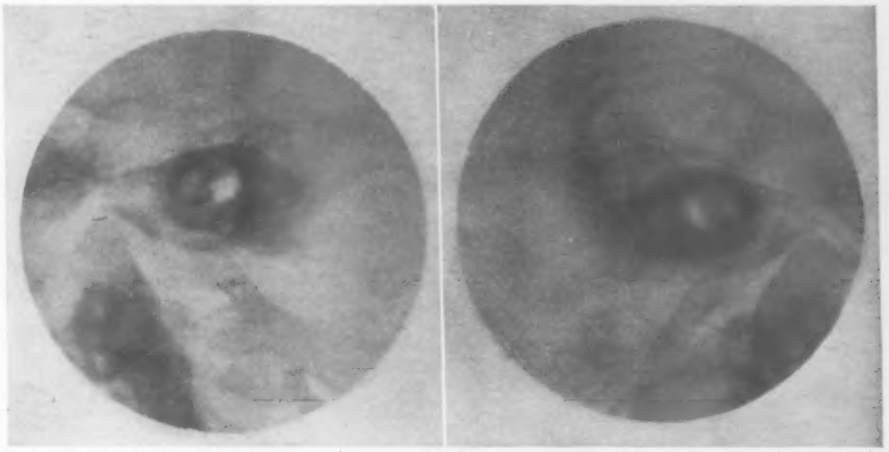

FIG. 2. The mastoid areas of a baby four and a half months old. Note the semicircular canals and the cochlea. The mastoid cavity is barely visible posterior to the upper semicircular canal.

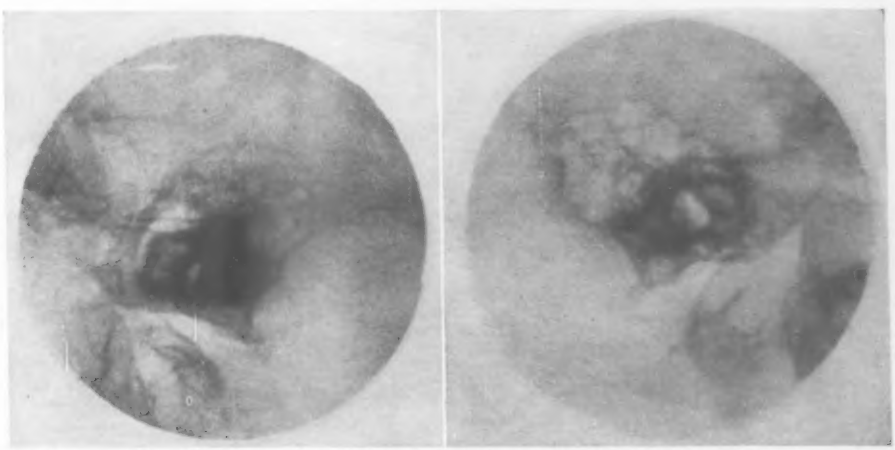

FIG. 3. Left-sided mastoiditis with pus formation in a baby nine months old, proved at operation. Note the unusual mastoid development.

The observations described in the foregoing paragraph are not in agreement with generally accepted anatomical knowledge. The following statement relative to the mastoid appears in Cunningham's Anatomy: "It only assumes its nipple-like form about the second year. Towards puberty its cancellous tissue becomes permeated with air spaces which are in communication with an extension from the mastoid antrum." Schwartz, in fortifying his position opposing mastoid operations in babies, says, "To speak of mastoidectomy in an infant is at least a misnomer, —one cannot cut out what virtually does not exist."

Piersol says, "As the mastoid process develops, the original diploetic structure is usually more or less replaced by larger cavities forming the pneumatic type." Since diploetic structure may be encountered at any age and since most of the infantile mastoids in this series showed no such structure at any stage of develop-

ment it seems likely that a mastoid remains a diploetic or a pneumatic type from the start. If this be true, it is incorrect to speak of diploetic mastoids in adults as infantile types.

After having examined a considerable number of babies in many of whom mastoid infection was only suspected, there is no longer any doubt in my mind as to the real value of the roentgen examination. It is true that some cases are encountered where the development is so poor that little information can be obtained, but fortunately they are not common.

Figure 3 shows the mastoid of a child nine months old who had suffered from repeated attacks of fever and running ears since the age of four months. For a week prior to admission to the hospital it was restless and vomited frequently and had a high fever. Operation was done on the left side soon after the roentgen examination and the mastoid cavity was found to be filled with gelatinous pus. The child did not show definite improvement and the right mastoid was opened two weeks later. However, it contained only a small amount of secretion. The patient developed a general infection before the last operation and died soon after it was done.

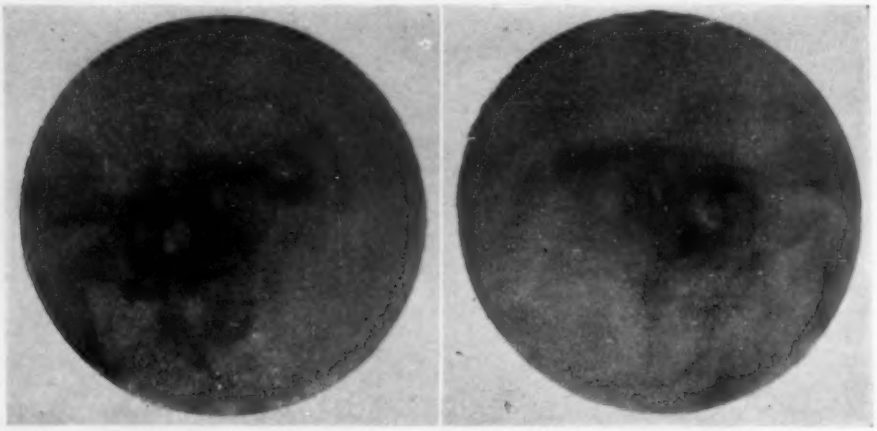

Fig. 4. Unusually small mastoids in a baby nine months old with double mastoiditis and an abscess on the right side proved by operation.

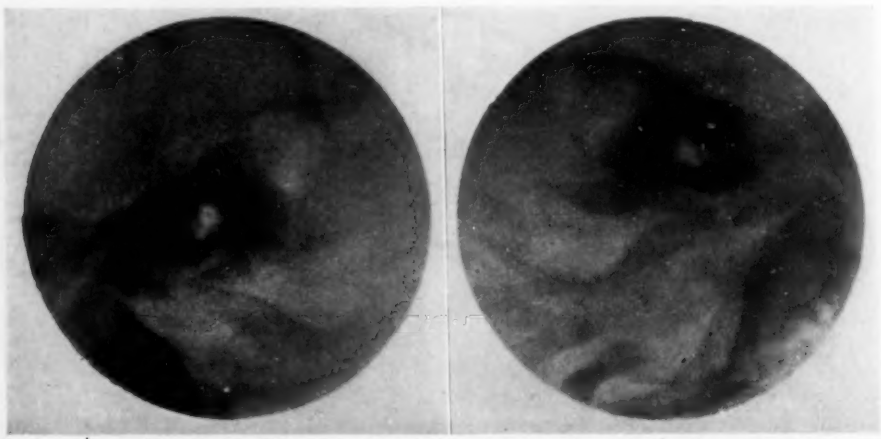

Fig. 5. Obliteration of left mastoid by pus in a baby nine months old. Findings checked by operation.

Figure 4 shows the mastoids of another nine months old baby who had had a bad cold for two weeks and a mild diarrhea with fever for a week. At the time of

admission the temperature was 104° and the white count was 15,300. The baby was quite ill. Considerable pus was found in the infant had had a cold for a week and had pulled at its ears, and had a temperature of 101° for three days. At admission

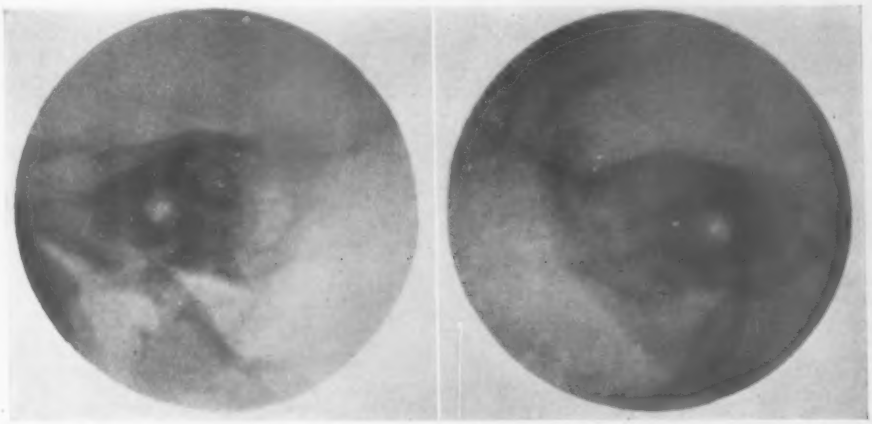

Fig. 6. Complete destruction of right mastoid with the formation of granulation tissue in a baby sixteen months old. Findings were checked at operation.

urine. The roentgenogram showed both mastoids very small and dense and on the right side an area of destruction almost replaced the mastoid. Much of the detail has been lost in reproduction and this its temperature was 104° and the white count was 14,600. Here again much detail has been lost in reproduction but the left mastoid shows a definite increased density. Operation showed the mastoid on the left

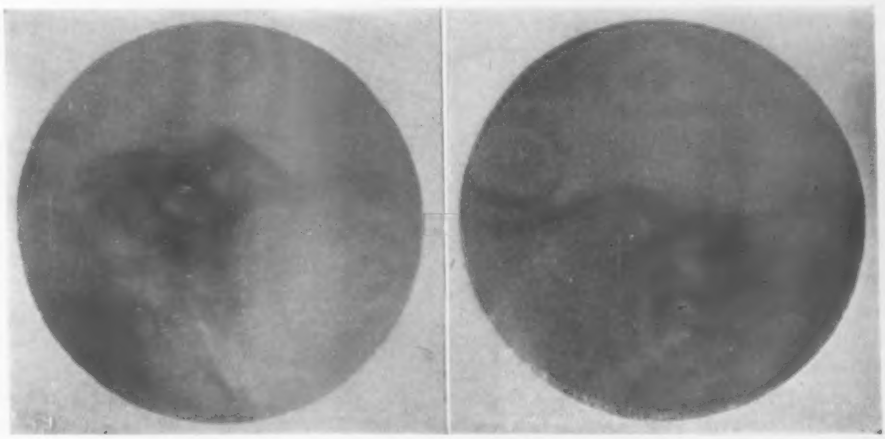

Fig. 7. Purulent infection of right mastoid in a baby eight months old.

change is not well shown in the illustration. Operation revealed pus on both sides and an abscess cavity in the right mastoid. The temperature dropped to normal soon after the operation and the baby did well. Although the mastoids were unusually small, the roentgenogram was helpful in this case.

The mastoids of a third baby nine months of age are shown in Figure 5. This side to be filled with pus. The child made a rapid recovery and was discharged in good condition on the seventh day.

Figure 6 illustrates the mastoids of a baby sixteen months old who during ten days of observation had an irregular temperature elevation and acted as though it had pain about the ears. Paracentesis obtained some drainage but did not improve the child's condition. The film

made on the tenth day showed an excessive degree of blurring and loss of outline in the right mastoid and very little change in the left one. Operation showed a large amount of pus and granulation tissue on the right side and a very slight amount of secretion in the left mastoid. The baby made a rapid recovery.

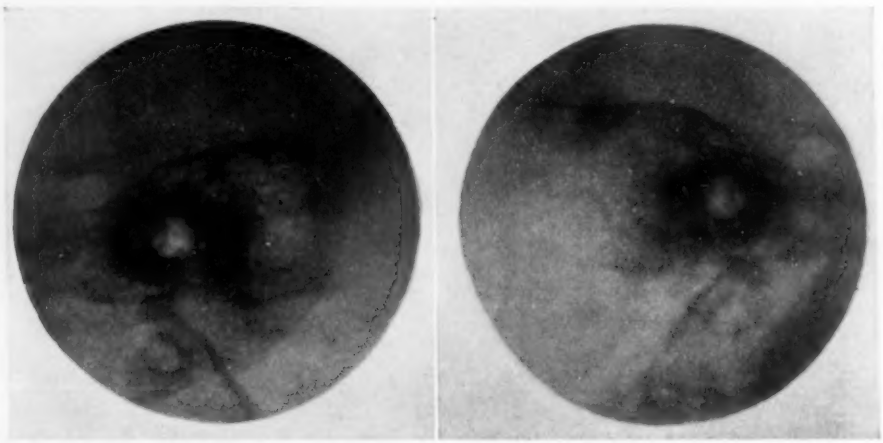

Fig. 8. Mastoids of a baby eighteen months old illustrating the early development of cell structure.

The presence of pus in the mastoid of a baby more than six months of age can usually be detected where the involvement is unilateral. However, double infections offer many difficulties. After becoming quite familiar with the appearance of normal mastoids with a given technique we have been able to locate pus on both sides on a number of occasions and feel that our success will be greater as our experience grows.

It is not the purpose of this paper to discuss the clinical picture or the proper treatment of infantile mastoiditis. A bibliography is appended for those who are interested in this side of the problem.

SUMMARY

1. After the age of six months a cavity having the shape of the mastoid can be demonstrated below the tegmen tympani and behind the external auditory meatus in good roentgenograms.

2. This cavity varies markedly in size and may measure ¾ of an inch in diameter and show definite cell structure by nine months, though such excessive development is unusual.

3. Diploetic mastoids are probably diploetic from the start, whereas cellular mastoids begin as large single cavities which slowly increase in size and usually begin to show cellular structure at nine to sixteen months.

4. The presence of pathological conditions of the mastoid can usually be detected in good roentgenograms after the age of six months, though double infections often make interpretation difficult.

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DISCUSSION

Dr. S. B. Roberts, Kansas City, Mo. The value of a roentgenogram of a mastoid either in infancy or old age has been demonstrated beyond a question of doubt. I do not mean that the otologist is entirely dependent on the roentgenologist for his diagnosis. It is only a question of the correlation of symptoms, and roentgenographic findings should determine that.

In the last few years a great deal of attention has been paid to it, and because of it no doubt the pendulum has swung too far and some of the less conservative pediatricians are pointing a finger of suspicion to the ear as a cause of intestinal disturbances. The findings by roentgenography are just as important as clinical findings, and in infants and very young children the roentgen ray is practically the only means of diagnosis. We term it latent because usually the clinical picture is not present at the time of the examination. There may have been suppuration from the ear which was not noticed by the parent or nurse. The ear may be dry on our first observation.

If no other cause can be found for these symptoms, either intestinal or otherwise, and the patient is not doing well under the usual treatment, the mastoid should be opened if the roentgen findings are positive. As a rule, it can be done with very little anesthetic either local or general.

The youngest patient on whom I have ever operated was eleven weeks old. This child was brought to the operating room as a last resort. She had been ill about two weeks running a high temperature, frequent bowel movements, somewhere between fifteen and twenty per day, marked emaciation, and when she was brought to the operating room her respirations were about eight per minute and the pupils were dilated. The pulse rate could not be determined because of its rapidity and weakness, and the patient was apparently in dire condition.

The roentgenologist reported he could see some difference in the two mastoids. She did have a discharging ear. I accepted the roentgenographic evidence in this child's case, and even though she seemed to be dying I hurriedly made an incision behind the ear under local anesthesia and opened the mastoid antrum which, of course, is all that is present in an eleven weeks old baby. We found distinct purulent material in that antrum. I merely put in a drain and didn't use any sutures and got her out of the operating room as quickly as possible. The child was better in a few hours.

In the second and third postoperative days the bowel movements had diminished two-thirds, or maybe more, and in two months the mother had a photograph taken of the baby showing that she had regained her normal weight for her age and made a complete recovery.

I am emphasizing this case because I had practically no evidence except the roentgenographic findings, and I agree with Dr. Martin that they are important in infants.

Dr. Wm. A. Evans, Detroit, Mich. In 1921, at the Los Angeles meeting, I read a paper on "The Value of the X-ray Study of the Mastoid in Children under Five" with the conclusions that mastoid structure of the adult, pneumatic type is frequently observed in very early infancy and that pathological changes incident to infection can be satisfactorily demonstrated and interpreted as to clinical stages of the disease. The scientific exhibit at the Detroit meeting included some of my cases of mastoid disease occurring in patients as young as ten days and a considerable number in the first few weeks or months of life, in which there was noted well-developed mastoid structure, and which demonstrated varying inflammatory stages.

Dr. Temple Fay, Philadelphia. I was extremely impressed with Dr. Martin's findings of an early process which may throw some light upon a subject that has demanded a great deal of interest from the standpoint of the neurological diagnosis and the later symptomatology that confuses us in a form of atypical neuralgia.

Perhaps the vagus in its close proximity to these structures is a most important factor in the symptoms which the patient discloses in the form of diarrhea, and perhaps in the vomiting. We have been able to demonstrate a very definite sensory function in the vagus in that area, and we hope to be able to present, before another year is over, evidence that the nerve supply which governs the so-called earache and symptoms referable to the posterior pharynx, symptoms which may be referred even to the tonsillar fossa and the tongue,

are all due to vagus branches of sensation given to various structures which go through this area.

Late in life we find symptoms arising from apparently old processes in the region of the mastoid. We have long searched for the cause of the so-called atypical neuralgia which, so far as we know, has no solution in a surgical procedure today. Yet certainly there has been a certain number of these cases showing sclerotic mastoids without any evidence of a fulminating ear disease that can be recalled, and in the proximity of the jugular foramen through the ninth, tenth and eleventh nerves pass just below these structures, which Dr. Martin has pointed out, taking its natural course after resolution.

I wish to make one point, that the roentgenologist today is the man who has the key to this situation. We would like to see the otolaryngologists perhaps more active in attacking this field. We feel that with the development of surgery there is no reason why a mastoidectomy should not be done early, or at any time. It certainly is not as dangerous as a neurosurgical procedure, and it may bring to light a great number of pathological conditions which have heretofore remained undisclosed. I believe the roentgenologist should have a great deal to say as to whether an operation is indicated or not, and that the otolaryngologist should find the opportunity for closer cooperation. A mastoidectomy is not a serious operation. It is in the fulminating state of the final disease because of the factors of infection which follow, but the early form of mastoidetomy leaves little trace if properly done, and it can be done for the benefit of certain cases, I am sure.

DR. F. M. LAW, New York City. I have to retract a statement. When I wrote my book I was perfectly sincere about the age of that infant, but this Spring I had occasion to x-ray an infant of twenty-one days, and I found a mastoid as big as an adult mastoid, and I felt very much chagrined.

At any rate, any infant of any age, from birth up, is entitled to an attempt at a satisfactory roentgenogram. I have in my possession a very good stereoscopic pair of a still-born infant and there is a mastoid process in that, so we can't make any statement as to when the mastoid does develop.

I do not think interpretation should be attempted on a film unless it is of such quality that the texture of the bones surrounding the mastoid process can be made out. Many times the opinion rests entirely, just as it does in the ethmoids, upon the detailed structure making up the mastoid cells. The mastoid can be likened to an ethmoid structure insofar as the interpretation is concerned. The mastoid film may not show opacity, or any material difference between the two sides, but there is a difference in the character of the cell structure. It may be thick, it may be translucent, it may be thin, the cell structure may even be gone, and yet due to the character of the bone making up the mastoid the density is not sufficient to produce a difference discernible between the two. So I think that any child or infant referred for an examination is entitled to that examination whether you succeed or not, and I think perhaps after a while when we become more skillful in handling the children we will get better results. I feel every attempt should be made to get all the information possible, but remember that it cannot always be done on the determination of the presence or absence of an opaque structure.

Pay attention to the detail of the bone itself. There are even times when there is a change in the appearance of the petrous portion. It may show a little more detailed in one infant than it does in another, and I feel that that change in density of the petrous portion, the portion particularly making up the cochlea, has a lining which, if we could work it out, will give information as to underlying conditions which are not evident in the mastoid structure itself.

DR. F. B. STEPHENSON, Denver, Colo. It occurs to me from my own experience and the work we have done in Denver at the Children's Hospital, where we have been getting mastoid plates on infants for a number of years, that the development as we see it here is largely in the petrous, or so-called petrous-squamous region of the skull, and the development as it occurs in later months proceeds downward into the mastoid process as the process itself develops.

DR. MARTIN (closing). There are just one or two points that I should like to go back over. First, about the mastoid antrum. I should have mentioned that. According to a number of authorities the mastoid antrum at birth is as large as it will be for several years afterwards, apparently about the size of a large pea and yet in none of my films have I been able to demonstrate a cavity in that region; so it is rather my opinion that the mastoid antrum probably isn't demonstrable.

Dr. Fay mentioned the advisability of having the roentgenologist give advice as to operation, and I meant to stress the point that regardless of how bad the process looks on the film the baby may get along beautifully. I mean you may have a very slight change, and yet the infection

may be so severe that the baby will die; or you may have a very severe looking infection on the film and the baby gets well.

I don't know whether we ought to make any statement relative to what should be done or not. Certainly where nothing was done the babies got along much better than I thought they would.

Dr. Law mentioned the fact that the two sides might look very much alike and yet there might be a good deal wrong, and that, of course, is where all the trouble comes.

I should also like to make the statement that I have usually erred in being too conservative. If the mastoids do not look right, there is usually a pathological condition there. It has been my experience that I am much more likely to underestimate than overestimate. Repeatedly where there were double infections I have been afraid to say anything and the surgeon reported that there was pus on both sides. I think probably we don't need to be too afraid to make a diagnosis or at least to say there is a pathological process present in this type of case.

There was one other thing mentioned that I should like to hear discussed: When does the middle ear become a mastoid? That is the thing that the pediatricians are asking all the time.

In some of these cases where we had a perfectly clear mastoid they have obtained pus from the antrum. The cavities we can demonstrate were clear in some of those cases, so I believe there are two different conditions, otitis media and a mastoiditis in a very young child.

Dr. Law. Might I just add one word? When does a middle ear become a mastoid? That can sometimes be determined by looking at the mastoid cell structure. If there is a mastoid involvement early, before pus has accumulated, the cell structure on this side will show a semi-translucent appearance similar to the edema which you get in the ethmoid. That is the difference.

Dr. Stephenson. I wish to make a correction in my discussion. I don't want to take credit for the mastoid work done there because I didn't institute it. I have been utilizing it, but I want to give the credit for the technique to Dr. W. W. Wasson, of Denver, who developed it.

THE EFFECT OF ROENTGEN RAYS ON THE RETICULO-ENDOTHELIAL SYSTEM*

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BY the term "reticulo-endothelial system"† we now understand the phagocytic cells of the spleen pulp, bone marrow, lymph glands, Kupffer cells of the liver and of the reticular tissue in general (Warthin). Its hemolytic function is only part of the important rôle in the organism, the more essential one being that of a phagocyte.[10] In the struggle of the organism against infection and malignant disease, as well as during periods of eliminating nuclear material from the blood, much depends on its readiness to respond. As a practical example, let us consider a case of malignant growth after irradiation by roentgen rays or radium when a quick resorption of the destroyed tissue is important. In this particular instance, the question arises whether or not an intensive exposure of the body, chiefly of the spleen or liver region, inhibits the function of the reticulo-endothelial system. On the other hand, small or moderate doses might be of benefit; one must only remember, in that connection, the therapeutic effect of small doses of roentgen rays in inflammatory disease. The exact mechanism of that action is still unknown.

† A review of the entire subject will be found in Aschoff, L. *Ergebn. d. inn. Med. u. Kinderb.*, 1924, xxvi, 1.

* Read by title at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17–20, 1929.

Schürer,[9] Zacherl,[12] and Mischtschenko[7] have worked on this assumption and studied the behavior of the reticulo-endothelial system in rabbits and guinea pigs after exposure to roentgen rays. They based the principal part of their experimental method on the fact that the reticulo-endothelial system absorbs electronegative colloidal substances. Congo-red, saccharated oxide of iron, and trypan-blue were injected intravenously at a certain time following the exposure and their disappearance from the blood stream was observed at chosen intervals. In some instances, the whole body had been irradiated; in others, the spleen only. The doses applied were not recorded by the above-mentioned authors in reproducible units; as a matter of fact, in one publication, they are designated only as heavy or small, and further details regarding the technique are lacking. In view of the importance of the problem, this suggested a repetition of these experiments on a systematic basis using graded and well-defined doses. It also seemed advisable to study the behavior of the injected dyes in a larger number of normal animals, in order to arrive at an acceptable mean value for comparison with the treated animals.

EXPERIMENTAL PART

The method employed by Schürer is a slight modification of the procedure worked out by Adler and Reimann[1] who studied the behavior of the reticulo-endothelial system in healthy and sick persons by recording the Congo-red content of the blood four minutes and one hour following intravenous injection. The same dye has been recommended by Griesbach[2] for the determination of the blood volume because it is non-toxic, does not stain the skin or conjunctiva and remains almost quantitatively in the blood stream for several minutes after the injections. Jaffé and Berman[6] do not believe Congo-red to be a suitable dye for testing the function of the reticulo-endothelial system. They injected 5 to 10 c.c. of a 1 per cent Congo-red solution intravenously in a group of rabbits, killed the animals from one-half hour to forty-eight hours later and did not find a trace of vital staining in any of the animals. They state that the dye was chiefly eliminated through liver and bile. If one studies the literature on vital staining, it appears that more dye than Jaffé and Berman used in their experiments must be injected in order to get satisfactory results. We repeated their experiments, and while no dye was found following injection of only 10 c.c. of a 1 per cent Congo-red solution, its presence in the reticulo-endothelial cells was evident if 100 c.c. was given over a three day period. If a smaller amount of dye is injected, it is quite possible that the dye concentration in a single cell is not sufficient to show microscopically. Adler and Reimann[1] injected 80 c.c. of a 1 per cent Congo-red solution intravenously in a patient several days before death and observed a few dye particles in spleen and liver. We did not believe that we should discard this method entirely but used in addition another dye, trypan-blue, in a second group of rabbits. It appeared that the latter dye is undoubtedly a better vital stain than Congo-red.

If 10 c.c. of a 1 per cent Congo-red solution is injected intravenously into normal rabbits, the dye is slowly eliminated from the blood. This agrees with the early investigations of Harris[3] who worked on dogs. The dye was always freshly prepared for the injection by dissolving it in physiological sodium chloride solution. The ear vein in rabbits offers a very convenient method for injection while the artery may be used for obtaining the blood samples later. At intervals of four minutes, one hour, two hours, up to twenty-four hours, 2 c.c. of blood was taken, allowed to separate spontaneously and then centrifuged at constant speed. One c.c. of serum was diluted with 1 to 5 c.c. of physiological sodium chloride solution and compared in the colorimeter (Bausch and Lomb Duboscq) with a standard solution. Four standard solutions were prepared by adding the required amounts of stock dye solution to normal rabbit serum, the mixture being diluted again with physiological sodium chloride solution. The standards contained 1, 0.5, 0.25 and 0.125 milligrams of dye in 10 c.c. of fluid. The concentration of

the dye is expressed in milligrams per 100 c.c. of serum. The results were computed by the following formula:

$$\frac{S}{R} \times 2 \times \frac{D}{10} \times \frac{100}{x} = \text{mg. Congo-red in 100 c.c. serum.}$$

In this formula S = depth of standard
R = reading of unknown
D = dilution of unknown
2 = mg. dye in standard
10 = dilution of standard
100 = factor to convert to 100 c.c. of serum.
x = amount of serum used

TABLE IA

INJECTION OF 10 C.C. 1 PER CENT CONGO-RED SOLUTION IN NORMAL RABBITS

Rabbit	Weight Gm.	Mg. Congo-red in 100 c.c. of Serum							
		4 Min.	1 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.	12 Hr.	24 Hr.
1	2550	87	71	26	12	8	1.2	0	0
2	2100	84	55	35	11	2	0	0	0
3	2500	70	25	13	3	0	0	0	0
4	2750	96	86	52	38	24	16	7	0
5	2390	77	50	28	13	3	0	0	0
6	2410	75	48	23	13	3	0	0	0
7	2820	90	66	40	15	3	0	0	0
8	2390	75	48	22	13	3	0	0	0
9	2500	91	60	28	10	1.3	0	0	0

From the preliminary tests in normal rabbits, we must conclude that there exists considerable individual variation (Table IA), much more than would appear from the data given by Schürer whose figures are added in parenthesis in Table IB. Inasmuch as his figures are expressed

TABLE IB

INJECTION OF 2 C.C. 1 PER CENT CONGO-RED SOLUTION IN NORMAL RABBITS

Rabbit	Weight, Gm.	Mg. Congo-red in 100 c.c. of Serum				
		4 Min.	1 Hr.	2 Hr.	4 Hr.	6 Hr.
10	1800	75 (74)*	35 (16)	15	0	
11	1900	85 (78)	40 (15)	35	22.5	0
12	2100	85 (82)	34.5 (14)	7.0	0	
13	2300	97.5 (80)	45 (14)	30	29	0

* The figures in parenthesis are taken from Schürer.[9]

in per cent and our own figures refer to 100 milligrams of dye injected, they are directly comparable. Assuming first that the difference in the amount of Congo-red injected might be responsible for this discrepancy,* we ran a series of animals which received the identical amount of Congo-red as in Schürer's experiments. As shown in Table IB, this did not alter our conclusions. There is also apparently no characteristic relation between elimination and weight.

Another method suggested itself which might serve to derive comparable normal figures. While different rabbits show differences in the elimination of the dye, the same rabbit might remain fairly constant in its behavior even following a second injection. Okuneff,[8] who worked with trypan-blue, reported that re-injection three days after the first injection is followed by approximately the same process of elimination as in the first test. Inasmuch as traces of the dye are still present after three days, he advises waiting a week before re-injection. We waited two weeks, and one month following the first administration of Congo-red before re-injecting the rabbits. As shown in Tables IIA and IIB, the elimination of the dye following the first and second injection in the same animal varies considerably. It cannot be recommended to study the elimination of the dye in a normal animal

TABLE IIA

INJECTION OF 10 C.C. 1 PER CENT CONGO-RED SOLUTION AND RE-INJECTION AFTER TWO WEEKS

Weight Gm.	Mg. Dye per 100 c.c. of Serum					
	4 Min.	1 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.
2750	96(66)*	86(40)	52(19)	38(8)	24(9)	16(0)
2410	75(66)	48(39)	23(15)	13(4)	3(3)	0(0)
2390	75(66)	48(50)	22(26)	13(14)	3(5)	0(0)
2500	91(61)	60(45)	28(31)	10(12)	1.3(1.2)	0(0)

* The figures in parenthesis represent the results following re-injection two weeks after the first injection.

TABLE IIB

INJECTION OF 10 C.C. 1 PER CENT CONGO-RED SOLUTION AND RE-INJECTION AFTER ONE MONTH

Weight, Gm.	Mg. Dye per 100 c.c. of Serum					
	4 Min.	1 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.
2550	87(50)*	71(38)	26(33)	12(19)	8(4)	1.2(0)
2100	84(60)	55(47)	35(37)	11(24)	2(10)	0(0)
2500	70(47)	25(31)	13(25)	3(18)	0(4)	0(0)

* The figures in parenthesis represent the results following re-injection one month after the first injection.

* Tests carried out on samples selected at random did not show the presence of Hb. We are indebted to Dr. C. W. Muehlberger, state toxicologist, for carrying out the spectroscopic tests for us.

first and then use these figures as a basis for comparison with the behavior following irradiation of the same rabbit.

The identical experiments were carried out with trypan-blue. The results are presented in Tables III, IVA, and IVB; they

TABLE III

INJECTION OF 10 C.C. 1 PER CENT TRYPAN-BLUE SOLUTION IN NORMAL RABBITS

Rabbit	Weight, Gm.	Mg. Dye in 100 c.c. of Serum								
		4 Min.	1 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.	24 Hr.	48 Hr.	72 Hr.
14	2600	81	40	33	31	25.0	22	16	2.0	trace
15	2500	78	51	27	24	23.0	11	9	1.3	trace
16	2480	78	50	30	30	24.0	18	10	2.0	trace
17	2600	75	48	29	23	20.0	17	9	2.0	trace
18	3000	50	40	24	23	15.0	15	12	3.0	trace
19	2300	70	58	25	19	17.0	15	12.5	2.0	trace
20	2500	50	40	30	25	22.5	20	10	2.4	trace

TABLE IVA

INJECTION OF 10 C.C. OF 1 PER CENT TRYPAN-BLUE SOLUTION WITH RE-INJECTION OF THE SAME AMOUNT ONE WEEK LATER

Weight, Gm.	Mg. Dye per 100 c.c. of Serum						
	4 Min.	1 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.	24 Hr.
3000	50(44)*	40(28)	24(15)	23(14)	15.0(13)	15(12)	12.0(7)
2300	70(54)	58(34)	25(20)	19(18)	17.0(16)	15(14)	12.5(11)
2500	50(48)	40(33)	30(18)	25(15)	22.5(13)	20(13)	10.0(8)

* The figures in parenthesis represent the results following re-injection one week after the first injection.

are very similar to those following injection of Congo-red. The elimination curve agrees well with that published by Okuneff[8] who used 8 c.c. of a 1 per cent trypan-blue solution. No direct comparison can be made with the work of Mischtschenko because he does not indicate the amount of dye injected. As to the results of the re-injections one week and one month after the first administration of trypan blue, we were unable to confirm the statement of Okuneff. The rate of the second elimination differs from that in the first test, an observation which we had made before in the experiments with Congo-red.

Fully realizing the limitations of the dye test, a group of rabbits was then exposed to roentgen rays using the following technique: 140 kv., 4 ma., 50 cm. focus skin distance, 4.0 mm. Al, lambda effective = 0.27 Å (measured through 4.0 mm. Al), air value: 0.24 R per second.[4] Schürer[9] administered 2 H through 3.0 mm. Al, at 160 kv. and 40 cm. focus skin distance. According to Wetterer,[11] this should correspond to approximately 170 R. We chose a dose of 150 R applied over the posterior body in the region of the spleen through a field of 5 cm. by 2 cm. This area is large enough to allow for variations in the position of the spleen which cannot be exactly defined in the living animal. Dye was injected immediately, one hour, and four hours, after the treatment. Sometimes double the dose was given over the spleen and also over the entire body. The latter procedure seemed advisable in view of the investigations of Holtermann.[5] He saw an increased vital staining with trypan-blue in mice whether the whole body or some part had been irradiated. This would speak for an indirect effect of the irradiation. The results of these experiments are compiled in Table V.

In the tests with trypan-blue, the whole body or the spleen alone was exposed with the same type of radiation; doses of 300 R and 600 R were used followed by dye injection immediately or two hours later (Table VI). This should permit a comparison with the investigations of Mischtschenko.[7]

Schürer also injected India ink (2 to 4 c.c. of a 50 per cent solution) in a number of rabbits eight hours after exposure of the spleen. The animals were killed exactly

TABLE IVB

INJECTION OF 10 C.C. OF 1 PER CENT TRYPAN-BLUE SOLUTION WITH RE-INJECTION OF THE SAME AMOUNT ONE MONTH LATER

Weight, Gm.	Mg. Dye per 100 c.c. of Serum								
	4 Min.	1 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.	24 Hr.	48 Hr.	72 Hr.
2600	81(54)*	40(40)	33(18)	31(17)	25(16)	22(14)	16(18)	2.0(2)	trace
2500	78(80)	51(40)	27(24)	24(20)	23(19)	11(18)	9(16)	1.3(10)	trace(3)
2480	78(60)	50(30)	30(15)	30(12)	24(10)	18(7)	10(7)	2.0(3)	trace

* The figures in parenthesis represent the results following re-injection one month after the first injection.

TABLE V

INJECTION OF 1 PER CENT CONGO-RED SOLUTION FOLLOWING IRRADIATION

Rabbit	Weight, Gm.	Mg. Dye Injected	Interval between Exposue and injection	Dose in R	Part Exposed	Mg. Dye in 100 c.c. of Serum						
						4 Min.	1 Hr.	2 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.
21	2140	20	1 hr.	150	Spleen	11*	6.9	1.4	0	..	..	...
22	2000	20	1 hr.	150	Spleen	13*	8.0	3.0	0	..	..	...
23	2100	20	1 hr.	150	Spleen	10*	5.0	3.0	0	..	..	...
24	2190	20	0	300	Spleen	18*	8.0	4.0	0	..	..	...
25	2100	20	0	300	Spleen	14*	5.0	0	..	..	..	...
53	2300	20	0	300	Spleen	15*	9.0	0	..	..	..	...
26	2340	100	0	150	Body	76	50	23	44	34	32	1.3
27	2490	100	0	150	Body	75	53	33	28	12	0	...
28	1790	100	0	150	Body	86	80	47	22	20	7	0
29	1970	100	0	300	Body	67	37	21	20	20	3	0
30	2290	100	0	300	Body	96	64	62	58	4	0	...
31	2800	100	0	300	Body	91	70	55	35	25	21	3
32	3000	100	1 hr.	150	Body	53	32	29	17	5	0	...
33	2940	100	1 hr.	150	Body	83	70	47	35	31	25	20†
34	1775	100	1 hr.	150	Body	76	65	50	20	7	0	...
35	2140	100	1 hr.	300	Body	50	34	....	23	20	7	0
54	2900	100	1 hr.	300	Body.	94	85	65	43	26	13	0
55	3000	100	1 hr.	300	Body	96	70	53	35	18	5	0
36	2350	100	4 hr.	150	Body	88	55	42	26	22	12	...
37	2180	100	4 hr.	150	Body	73	64	49	22	5	0	...
56	2700	100	4 hr.	150	Body	75	54	51	43	41	26	9
57	2700	20	4 hr.	150	Spleen	16*	12	6	0	..	..	...
58	2600	20	4 hr.	150	Spleen	17*	5	0	..	..	..	...
59	2800	20	4 hr.	150	Spleen	18*	5.3	0	..	..	..	...

* By multiplying these figures by 5, they can be directly compared with the other results.
† Dye eliminated completely within 24 hours.

thirty minutes afterward, the organs placed in alcohol and studied microscopically. We repeated these experiments on 8 treated and 5 untreated rabbits as controls. In addition, the identical tests were carried out on 3 animals with one hour interval between treatment and injection, using again 3 normal rabbits as controls. In Figures 1, 2, and 3, the photomicrographs of the spleen of one unexposed and two exposed rabbits selected at random demonstrate the results.

DISCUSSION OF RESULTS

In view of the considerable amount of individual variation in the elimination of the dye from the blood even in so-called normal rabbits, the mean values of the experimental results have been calculated and compiled in Tables VII (Congo-red) and VIII (trypan-blue). There is fair agreement between our own average values and the corresponding figures of Schürer as to the amount of Congo-red in the serum four minutes after injection if 100 mg. or 20 mg. of dye was injected. The one hour values differ; they are higher for the 100 mg. injection, but even in the case of the 20 mg. injection decidedly higher than the figures reported by Schürer. Our findings in rabbits treated over the spleen (150 R) and injected one hour after the exposure are entirely opposite to his results. While Schürer noted a decrease in the elimination of the dye from the blood under these conditions, we observed a faster resorption. However, doubling the dose and injecting immediately after the treatment shows the values again close to those seen in normal animals. Injection immediately after exposure of the whole body with 150 R or twice that dose is followed by an elimination rate similar to that in untreated rabbits while an injection one hour after irradiation of the entire body with 150 R seems to increase the speed of elimination slightly. A comparison of rabbits 35, 54 and 55 shows how

TABLE VI

INJECTION OF 10 C.C. OF 1 PER CENT TRYPAN-BLUE SOLUTION FOLLOWING IRRADIATION

Rabbit	Weight,	Interval between Exposure and Injection	Dose in R	Part Exposed	Mg. Dye in 100 c.c. of Serum									
					4 Min.	1 Hr.	2 Hr.	4 Hr.	6 Hr.	8 Hr.	10 Hr.	24 Hr.	48 Hr.	72 Hr.
38	2800	2 hr.	300	body	43	31	23	19	16	13	11	6	2	?
39	2200	2 hr.	300	body	54	30	28	19	13	12	10	9	6	..
40	3300	2 hr.	300	body	48	36	25	25	25	13	9	5	3	..
41	2400	2 hr.	600	body	74	40	36	26	25	23	20	19	8	3
42	1800	2 hr.	600	body	70	35	25	20	20	19	19	19	17	10
43	2600	2 hr.	600	body	71	56	23	17	15	14	13	13	..	..
44	2100	0	300	spleen	69	30	27	28	19	14	12	8	4	..
45	2100	0	300	spleen	55	32	21	18	17	16	10	8	3	..
46	1900	0	300	spleen	52	36	30	17	12	10	9	5	2	..
47	2900	0	300	body	48	37	34	32	30	22	17	14	8	5
48	2400	0	300	body	64	43	40	34	18	15	15	12	..	..
49	2700	0	300	body	66	50	38	24	20	18	16	11	10	..
50	3400	0	600	body	50	40	30	24	24	22	15	15	8	3
51	2900	0	600	body	57	45	24	22	20	19	15	13	0	0
52	3200	0	600	body	50	38	35	25	18	17	17	11	..	..

TABLE VII

RESULTS IN MEAN VALUES COMPILED FOR EXPERIMENT WITH CONGO-RED

Mg. Dye Injected	Mg. Dye in 100 c.c. Serum		Dose in R	Interval between Exposure and Injection	No. of Rabbits	Remarks
	4 Min.	1 Hr.				
100	82.8	56.5	...	....	9	Normal average
20	84.6	39.9	...	....	6	Normal average
20	78.5	14.7	...	....	4	Taken from Table 1 of Schürer
20	56.5	33.0	150	1 hr.	3	Spleen exposed
20	100.0	62.0	2H	1 hr.	1	Spleen exposed (Schürer)
20	78.5	36.5	300	0	3	Spleen exposed
100	79.0	61.0	150	0	3	Whole body exposed
100	84.7	57.0	300	0	3	Whole body exposed
100	70.7	55.7	150	1 hr.	3	Whole body exposed
100	80.0	63.0	300	1 hr.	3	Whole body exposed
100	78.7	57.7	150	4 hr.	3	Whole body exposed
20	90.0	35.0	2H	4 hr.	2	Spleen exposed (Schürer)
20	85.0	37.0	150	4 hr.	3	Spleen exposed

essential it is to use more than one animal in each group. Increasing the time interval between the exposure of the body and the injection to four hours does not seem to alter the elimination rate. Similar results were obtained by exposing the spleen only followed four hours later by injection of 20 mg. of dye. The latter figures agree well with those reported by Schürer (Table VII, last group). They are, however, almost identical with our normal average. A careful study of Tables V and VII demonstrates clearly that no conclusions should be drawn based on tests in a single animal. If anything can be deduced from Table VII, one may say that there is evidence of a more rapid resorption of Congo-red following exposure of the spleen to 150 R applied one hour before injection of the dye. Exposure of the spleen or of the whole body immediately preceding the injection does not produce any characteristic variations from the figures obtained in untreated rabbits.

The averaged results with trypan-blue are presented in Table VIII. As a whole there is less variation in the elimination of trypan-blue if the animals received an "erythema dose" over the whole body followed by injection of a trypan-blue

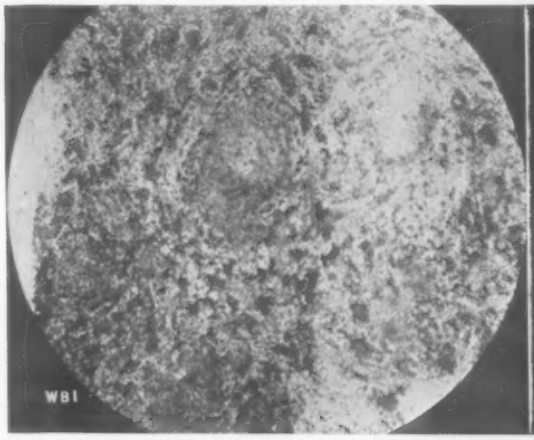

Fig. 1. Normal rabbit. The ink particles are diffusely deposited in the pulp with a definite tendency to heavier grouping.

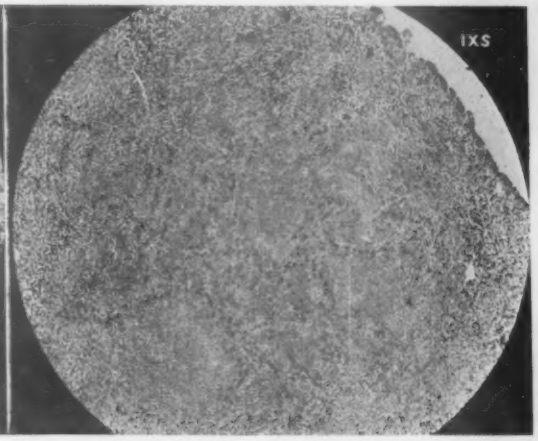

Fig. 2. Rabbit irradiated eight hours before injection. The ink particles are diffusely deposited in the pulp while the lymph follicles are entirely free.

rate than in the first group which was injected with Congo-red. It seems that a dose of 300 R over the whole body followed by an injection of trypan-blue two hours later leads to a more rapid elimination of

Table VIII

Results in mean values compiled for experiments with trypan-blue

Mg. Dye in 100 c.c. Serum		Dose in R	Interval between Exposure and Injection	No. of rabbits	Remarks
4 Min.	1 Hr.				
68.8	46.7	...	...	7	100 mg. dye injected.
48.3	32.3	300	2 hr.	3	Whole body exposed.
71.7	43.7	600	2 hr.	3	Whole body exposed.
58.7	32.7	300	0	3	Spleen exposed.
59.3	43.3	300	0	3	Whole body exposed.
52.3	41.0	600	0	3	Whole body exposed.

the dye from the blood. Doubling the dose changes the averaged results materially; the figures approach the normal values. Exposure of the spleen only to 300 R followed immediately by injection of the dye increases the rate of elimination more at the one hour period, while exposure of the whole body has very little effect. Doubling the dose over the whole body leads to a more rapid elimination at the four minute period. Our observations are at variance with those of Mischtschenko who found in his rabbits a considerable decrease of the elimination rate

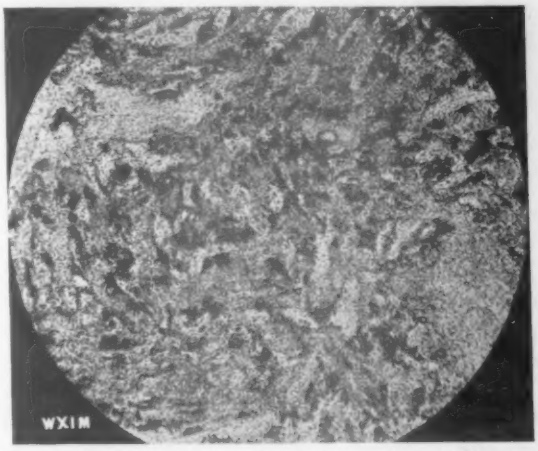

Fig. 3. Rabbit irradiated one hour before injection. The ink particles are deposited in clumps with a tendency towards grouping about the margins of the larger sinuses.

solution (quantity not stated) two hours after the exposure.

A very interesting phenomenon was observed in the rabbits injected with 10 c.c. of a 1 per cent trypan-blue solution following irradiation of the spleen or of the whole body. While none of the untreated animals showed any disturbance after the injection, all irradiated rabbits developed marked symptoms of intoxication four to six hours after injection if the whole body

had been exposed. In those that received an exposure over the spleen only, the attacks occurred six to eight hours after the injection. The symptoms consisted of rapid and labored breathing, a mucous discharge and sometimes hemorrhage from mouth and nose. After a reduction of the injected dye to 20 mg., the toxic effect could not be produced.

The last group of experiments concerns the elimination of India ink from the blood. Schürer reported that in the spleen and liver of normal rabbits which were killed one-half hour after injection of 2 to 4 c.c. of 50 per cent India ink solution, very few ink particles are found microscopically. The opposite was observed in rabbits which had been irradiated over the spleen eight hours prior to the injection. Figure 1 represents the photomicrograph of the spleen of a normal rabbit; it is evident that the cells are loaded with ink particles. A total of 8 rabbits was examined; they all presented the same result. Considerably less ink deposit was found in the spleen and liver of the animals treated eight hours before the injection (see Fig. 2). This is at variance with the findings of Schürer, and as we followed his technique very closely, we cannot explain the discrepancy. In order to study the influence of the time interval between irradiation and injection, a second group of 3 rabbits was injected with 3 c.c. of a 50 per cent India ink solution one hour after the exposure of the spleen (150 R). Three untreated animals served as controls. Figure 3 shows the photomicrograph of the spleen of one treated animal. A comparison with Figure 2 reveals the fact that there is as much or slightly more ink deposited than in the normal control.*

This would be in accordance with our observations following injection of Congo-red. If the dye was administered one hour after the exposure of the spleen, the elimination from the blood seemed to be more rapid than in the untreated control. It appears then from these findings that a partial blockade of the reticulo-endothelial system manifested itself eight hours after the exposure while no inhibitory effect could be detected with the method used one hour following irradiation.

SUMMARY

1. The function of the reticulo-endothelial system has been studied by recording the elimination of Congo-red and trypan-blue injections in the ear vein of rabbits after exposure to roentgen rays. The limitations of this method are discussed.

2. The presence of considerable individual variation in the animals renders a precise interpretation of the results difficult. The rôle played by the part exposed, by the dose and by the time interval between irradiation and injection is too complicated to be expressed in a simple formula. Our findings are at variance with those reported by previous investigators.

3. A toxic reaction following injection of trypan-blue in rabbits if preceded by irradiation is described. As far as we could ascertain, this phenomenon has not been reported before.

4. In view of the fact that the reticulo-endothelial system extends throughout the whole organism and as we know so little about the factors controlling its function, any attempt at an explanation of the observed reactions leads to speculation. No theory is offered, therefore, to explain the results of our experiments but they are simply presented as the basis for further research.

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GENERALIZED ABDOMINAL CARCINOMATOSIS OF OVARIAN ORIGIN

REPORT OF THREE CASES TREATED BY IRRADIATED AUTOGENOUS ASCITIC FLUID AND DEEP ROENTGEN THERAPY*

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THREE cases are here reported of ovarian carcinoma with generalized abdominal carcinomatosis which were treated by deep roentgen therapy and subcutaneous injections of irradiated autogenous ascitic fluid. The ascitic fluid was irradiated to destroy all the malignant cells which might be present, and was used instead of heat. Whitehouse,[1] obtained astonishingly excellent results in a case similar in most respects to ours. He supplemented the use of the ascitic fluid with a transfusion of 500 c.c. of blood from a woman ten weeks pregnant, regarding the syncytiolysin present in the pregnant woman's blood as an important addition to his patient's blood in affecting the growth of the malignant process. In his case, ascites did not recur after the sixth injection of the serum. At operation, a mass the size of an orange was seen to be in Douglas' pouch. A histological section from this mass proved to be adenocarcinoma. This mass could be palpated *per vaginam*, but after eight months was no longer palpable. It was therefore considered to have completely disappeared. Her condition had improved also pari passu and she was apparently free from disease as far as could be determined by examination, eight months after the operation. We were unable to procure blood from a pregnant woman for transfusion in any of our cases and since we already knew the very marked effect deep roentgen therapy often has in this type of growth, we substituted this form of therapy for the transfusion.[2] The ascitic fluid was collected aseptically; 1000 c.c. was irradiated with 100 mg. radium for twenty-four hours, shaking it from time to time, and it was then put up in sterile 10 c.c. ampules by Dr. John Kolmer and injected subcutaneously three times weekly as outlined in the actual case reports which follow. Deep roentgen therapy was given simultaneously in each case. The factors which made up an erythema dose were 200 kv., 4 ma., 96 min., 50 cm. distance, 0.5 mm. Cu and 1.0 mm. Al as filter. The actual dose given at any one time was adapted to the patient's condition, being controlled in each instance by the use of the saturation curves, and the treatment was carried out according to the saturation method.[3]

CASE REPORTS

Case 1. Mrs. L. W., Jewess, aged thirty-nine, was admitted to the Medico-Chiurgical Hospital on May 23, 1927, complaining of a painfully distended abdomen.

The patient was in comparatively good health until about two weeks before admission when she noticed some enlargement of the abdomen which seemed to increase rapidly. Pain developed a few days before admission.

Examination revealed a weak, sallow, somewhat undernourished female, appearing about

*From the Radiological Department of the Graduate Hospital. Presented before the Philadelphia Roentgen Society, April 4, 1929.

forty-five years of age. Signs of increased mediastinal dullness were discovered and the abdomen was markedly distended with fluid, measuring 78 cm. in its greatest circumference. Roentgen examination revealed an encapsulated, partially calcified mass, smooth in outline, egg-shaped, measuring 7 × 11 cm. overlying the left cardiac margin and apparently springing from the anterior mediastinum in the lateral view of the chest. This mass was regarded as a mediastinal cyst, possibly dermoid, or an old calcified, encapsulated empyema. The laboratory studies were relevantly negative. Examination of the first ascitic fluid obtained, disclosed many endothelial and carcinomatous cells while the smears and cultures were negative for tubercle bacilli.

Deep roentgen therapy was given immediately through three fields 18 × 20 cm. over the entire anterior abdomen, centering over the umbilical region and one on either anterolateral aspect of the abdomen. One dose was given to one field daily, 25 per cent of a skin erythema as each dose. This treatment was continued by the saturation method until 150 per cent of a skin erythema dose was given to each portal. Except for the indicated medical measures, nothing but deep roentgen therapy was given at this time.

During the first month, there was no appreciable change in the patient's condition and paracentesis was done twice more. A nodule about 1 cm. in diameter then developed at the site of the paracentesis puncture. This was removed and studied histologically and reported as metastatic adenocarcinoma. During the second month, it was necessary to tap her abdomen only once. She was gaining in weight and strength and there was a very encouraging improvement discernible in her general condition. It was therefore thought advisable to continue the roentgen therapy until each portal received a total skin value of 200 per cent of an erythema dose. The patient continued to improve as a result of roentgen therapy alone. No palpable masses were ever discovered in her abdomen. She was discharged from the hospital on Sept. 30, 1927, the last paracentesis having been done eight weeks previously.

For the next four weeks, she felt strong enough to attend to a little grocery store which she had been conducting. At this time, her abdomen was considerably swollen again and she returned to the hospital for relief.

She was again admitted on Oct. 1, 1927, for paracentesis, at which time 1000 c.c. of the ascitic fluid was collected and irradiated with 100 mg. radium for twenty-four hours under aseptic precautions and placed in sterile 10 c.c. ampules. A pneumoperitoneum was also done at this time and the roentgenograms revealed a large tumor mass overlying the right sacroiliac region, measuring about 10 cm. in diameter. Otherwise there was no evidence of malignancy present in the abdomen. Deep roentgen therapy was again given through the same three portals and through an additional portal 18 × 18 cm. on the back over the sacroiliac regions. This treatment was continued until the anterior abdominal portals received each a total of 350 per cent of a skin erythema dose. The posterior portal was given five 25 per cent erythema doses on successive days. Subcutaneous injections of the irradiated ascitic fluid were given two and three times weekly from this time until the patient's death.

The day following the pneumoperitoneal study, the patient developed rather acute abdominal pain, constipation and a fever ranging from 99° to 100°F. daily. These symptoms lasted for two weeks, after which they subsided and the patient felt more comfortable than at any time since the onset of her illness. There was some accumulation of the abdominal fluid during the next few weeks, but never enough to warrant paracentesis at any time during the remainder of her illness. There were no complaints now excepting constipation which was becoming progressively more recalcitrant to treatment. During the last three weeks of her illness, alternate constipation and diarrhea supervened and just before her death on March 31, 1928, she developed acute intestinal obstruction.

Autopsy revealed a thin, emaciated female with secondary carcinoma of the anterior abdominal wall at the site of paracentesis puncture, dense adhesive peritonitis binding the intestines together and walling off the pelvis, carcinomatous infiltration of the omentum and peritoneum with adhesions, a small collection of blood-stained ascitic fluid, a primary cystic carcinoma of the right ovary, and a calcified cyst of the anterior and superior mediastinum probably an old hemorrhagic cyst, but with no evidence of malignant degeneration. Histological studies showed carcinomatous metastasis to the spleen, stomach, liver, peritoneum and diaphragm.

CASE II. Mrs. M. G., Jewess, aged thirty-three, was admitted to the Graduate Hospital on Dec. 12, 1927, complaining of abdominal distention.

Two months before admission, the patient had an abdominal operation and a large right ovarian cyst was removed which was not regarded as malignant. Two weeks later, she noticed an enlargement of her abdomen which painlessly, rapidly and steadily increased.

The patient was a small statured, sallow Jewess, underweight, with a marked thoracic and lumbar kyphoscoliosis. The abdomen was markedly enlarged, distended and tense, due to ascites.

Paracentesis was done the day following admission and since the smears and cultures were negative for tubercle bacilli, this finding and the rapid onset of ascites after operation suggested a diagnosis of malignancy. The laboratory and roentgen examinations were relevantly negative.

Deep roentgen therapy was given immediately through three anterior abdominal portals, as in the previous case, by the saturation method, 20 per cent of a dose being the maximum that could be given at one time because of the nausea and vomiting that ensued if a larger dose was given. Subcutaneous injections of 10 c.c. of autogenous irradiated ascitic fluid were given twice weekly. This therapy was continued until the end, except for one interruption of two weeks, and another of eleven weeks, during which time the patient was away convalescing at a seashore resort.

During the first few weeks, the patient's condition was distinctly improved and a paracentesis was done only twice within the first five weeks. It had to be done only three more times during the ensuing sixteen weeks. She felt well and strong enough to leave the hospital after the second admission, which was only to have a paracentesis done. She spent the following eleven weeks at a seashore resort, but during the two weeks preceding her third admission April 7, 1928, her condition had become steadily worse and marked abdominal distention again developed.

She was now quite emaciated and decidedly weaker. A cough had developed which was nonproductive, but persistent. The abdomen was distended, but there did not seem to be enough fluid present to warrant paracentesis.

Constipation, which had become apparent during her sojourn at the resort, now became very marked and on May 7, 1928, signs of acute intestinal obstruction were discovered. Surgical intervention became absolutely necessary, resulted in a colostomy, removal of 125 oz. of sanguineous fluid from the abdomen, the removal of a right cystic ovary, and a section from the anterior abdominal wall which seemed to be infiltrated with malignant tissue. The surgeon also noted the presence of a diffuse abdominal carcinomatosis. The patient died several hours after the operation.

The pathologist reported that the section of abdominal tissue contained papillary carcinomatous infiltration.

Roentgen therapy was also given in this case; the lateral lumbar portals 20 × 18 cm., receiving a total of only 140 per cent skin erythema dose; the anterior abdominal portal received 220 per cent skin erythema dose and the posterior field from the tenth rib to the ischial tuberosities received 265 per cent skin erythema dose. Estimating the center of the abdominal pathological process as on the level with the iliac crests in the center of the abdomen, a total of only 78 per cent of an erythema dose was received by the tumor tissue itself. Twenty-two subcutaneous injections of the irradiated ascitic fluid were given, making a total of 220 c.c.

Case III. Mrs. L. K., Jewess, aged forty-eight, housewife, was admitted to the Graduate Hospital on Jan. 6, 1928, complaining of abdominal swelling. Six months before admission, a pessary for retroversion was advised by her physician. Four months later, she was operated on in another hospital for the uterine trouble, at which time a cyst of the right ovary was found and a section removed for microscopic study because evidence of malignant peritoneal metastasis was present. A report of non-malignancy was made from this study. One week after the operation, her abdomen began to swell rather suddenly, necessitating a paracentesis within three weeks. Two weeks later, painless swelling of the abdomen again recurred and progressed quite rapidly just before admission to the Graduate Hospital.

Examination after admission revealed an emaciated, sallow, adult female, appearing fifty-five years of age. The abdomen was markedly distended, measuring 88 cm. in its greatest circumference. Palpable masses could be felt through the abdominal wall in the left hypochondriac region, but the pelvic structures could not be definitely outlined. The examining hand simply met resistance across the entire pelvis. There were enlarged, firm, discrete lymph nodes in each groin, the largest measuring about 3 cm. in length. Roentgen examination revealed no evidence of metastasis to the bones of the pelvis, lumbar or dorsal spine, ribs or lungs. There were no other abnormal physical or laboratory findings.

Paracentesis was done two days after admission and 6540 c.c. of straw-colored ascitic fluid was withdrawn. Examination of the fluid was relevantly negative and animal inoculation subsequently proved it to be negative for tubercle bacilli. A lymph node was also removed from the right groin and histological study proved it to be the seat of metastatic carcinoma. A liter of the collected ascitic fluid was irradiated with 100 mg. radium for twenty-four hours in a cylindrical vessel with aseptic precautions and put in sterile 10 c.c. ampules.

Deep roentgen irradiation was directed to the pelvis through three portals, one anterior and two postero-oblique through the great sacrosciatic notches. Treatments were given daily in 25 per cent skin erythema doses through one portal at a time and subcutaneous injections of the irradiated ascitic fluid were given three times weekly. She also received four 25 per cent doses over the upper abdomen.

For the first few days after the beginning of this combined therapy, the patient was more hopeful and comfortable, but there seemed to be no retardation in the accumulation of the ascites, paracentesis being done again in two weeks. At this time, a pneumoperitoneum was done and the roentgenograms revealed large solid tumor masses in the pelvis and smaller ones scattered through the entire abdomen. Treatment was continued, however, in spite of the fact that the patient became progressively more uncomfortable, weaker and with no remission in the rapid repeated development of of ascites. She died on March 8, 1928, approximately three months after admission and after paracentesis had been done six more times at approximately two week intervals. Just before death she developed swelling of the lower extremities and acute intestinal obstruction, which was the immediate cause of death.

Autopsy revealed an acute serofibrinous peritonitis with diffuse carcinomatosis of the peritoneal cavity with dense fibrous adhesions in the pelvis involving all the organs. Mixed with these adhesions was recurrent carcinomatous tissue. There was a recurrent carcinoma of the right ovary with a multilocular cyst. There was macroscopic metastasis to the liver. Microscopic study revealed metastasis (adenocarcinoma) to the adrenals, stomach, intestines, pancreas, liver and lungs.

In this case, 23 injections of irradiated ascitic fluid were given (one three times weekly) totaling 230 c.c. A total of 165 per cent of a skin erythema dose was given over the anterior field and 150 per cent over each of the postero-oblique fields, in treating the pelvic process. This was given by the saturation method and a total estimated tumor dose (regarding the right ovary as the site about which the pelvic process centered) of 190 per cent of a skin erythema dose was given. One full erythema dose was given in four divided doses to the anterior upper half of the abdomen.

COMMENT

All three cases were admitted to the hospital for treatment after the onset of ascites. This might be regarded as a late stage of ovarian carcinoma. Ascites usually does not develop until after the occurrence of peritoneal metastasis and when this stage is reached, it is also very probable that metastasis to nearly all the abdominal organs has taken place. The problem of getting sufficient radiation into the primary tumor mass and its metastatic ramifications is involved and difficult because of the inability to accurately localize the lesions by physical or laboratory examinations. The distention caused by the ascites further greatly decreases the effective tumor irradiation obtainable. It becomes obvious that the entire abdomen must be irradiated either through many small portals or fewer large portals. The intestinal tract thus receives much irradiation which is unavoidable, and only small doses can be given at a time because radiation sickness quickly follows large doses in this class of patients. The first two cases were given considerable radiation, but by no means as much as the full possible limit that would be desirable in this type case. The third case was also given comparatively little roentgen radiation, yet all three showed some improvement after irradiation, the first and second much more decisively than the third. The supplementary injections of the irradiated autogenous ascitic fluid, twice as much in one case as in either of the other two, did not seem to modify the course of the disease in any of these cases. There were no local nor general reactions following any of the subcutaneous injections and no manifestations of its action could in any way be detected. All of the benefit obtained in these cases seemed to have been due to the irradiation, as one of us (G. E. P.) has previously reported good results in 13 cases of general abdominal carcinoma, and Keene, Pancoast and Pendergrass[1] have shown beneficial results from irradiation in inoperable carcinoma of the ovary. The fact that in two of the three cases, the tumor tissue was reported benign by microscopic examination and then ran a rapidly malignant course and that both showed extensive malignant metastases microscopically, would seem to indicate the advisability of irradiating those cases pronounced benign. It would seem that any improvement obtained in

these cases was due to the irradiation, and the fact that more satisfactory results had been obtained by one of us in the cases previously reported, would not only justify treatment in generalized ovarian carcinoma of the abdomen, but would indicate the advisability of irradiation immediately after the operation. So far as can be judged from our three cases, it would seem that the case reported by Whitehouse ended in recovery as a result of the blood transfusion from the ten weeks pregnant healthy woman, rather than from the irradiated ascitic fluid.

CONCLUSIONS

No synergistic effect was obtained from the subcutaneous injections of irradiated autogenous ascitic fluid used simultaneously with deep roentgen therapy in three cases of generalized abdominal carcinomatosis of ovarian origin.

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CASCADE OR WATERFALL STOMACH*

WITH REPORT OF THREE CASES

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CASCADE or waterfall stomach is an uncommon condition. A survey of the literature disclosed but few references to this subject. The condition may be defined as an hour-glass stomach of atypical form, characterized on roentgenologic examination by drawing up of the posterior wall so that the opaque mixture first fills the upper sac of the stomach and then cascades over into the lower sac. As in the case of hour-glass stomach, the deformity may arise from various causes. Of the three cases here reported, one was due to carcinoma of the cardiac end of the stomach; one, to lymphosarcoma intestinalis; and one, to pressure caused by an accumulation of gas in the descending colon.

REPORT OF CASES

Case I. J. M., male, aged seventy, complained of dysphagia, anorexia and loss of weight. Except for evidences of emaciation, oral sepsis and arterial hypertension, physical examination was negative. However, the abdomen was distended with gas from the cecum to the splenic flexure. Combined roentgenoscopy and roentgenography of the gastrointestinal tract by means of the contrast meal revealed a stomach of the cascade type lying almost transversely across the abdomen. It was divided into a small pouch on the left and a much larger sausage-shaped pouch on the right. The bubble, which was of enormous size, bridged the entire left pouch and part of the right in front of the spine. The entire stomach was rotated forward on its vertical axis, so that the greater curvatures occupied the position of an anterior border (Fig. 1).

Examination of the gastric contents revealed the classic evidences of malignant achylia gastrica.

The clinical diagnosis was carcinoma at the cardiac orifice of the stomach. Exploratory operation was refused and the patient died soon afterward.

Case II.* L. F., a printer, aged twenty-three, complained of gastric symptoms of one month's duration: principally pain, intermittent nausea and vomiting and marked abdominal distention. At times he had fever.

Abdominal examination revealed general

* This case was published elsewhere in greater detail. See *Am. J. Surg.*, 1928, iv, 554.

* Read before The Society for Clinical Study, of the City of New York, March 26, 1929.

distention but no palpable masses. During the examination borborygmus was pronounced. Roentgenoscopy without the contrast meal showed the colon to be distended with gas from the hepatic flexure to the sigmoid.

FIG. 1. Case I.

When the barium meal was administered, the stomach was found to be pushed to the extreme right by the markedly distended splenic portion of the transverse colon, which pressed against the greater curvature of the stomach so as to give it a cascade form. Roentgenologic examination after a barium enema showed complete obstruction to the passage of the medium in the vicinity of the splenic flexure (Fig. 2).

When laparotomy was performed, the intestines were found to be greatly distended and thickened. The appendix was covered with fibrin. It was removed and an enterostomy made at the tip of the cecum. A constricted mass of intestine was found at the splenic flexure. The patient died a few days after operation.*

Post-mortem examination disclosed gastro-intestinal pseudoleucemia, incomplete intestinal obstruction, purulent appendicitis, fibrino-purulent peritonitis and multiple hemorrhagic pulmonary infarcts. On histologic examination the lesion proved to be a lymphosarcoma.

CASE III. A salesgirl, aged twenty, stated that she had been ill for three years. Her gastric symptomatology suggested hyperacidity but was not typical of a pre- or postpyloric ulcer.

She was very pale and had the appearance of a person with chronic fatigue intoxication. The blood pressure was below normal. However, analysis of the gastric contents gave acidity figures within the normal range.

FIG. 2. Case II.

Roentgenologic examination with the contrast meal showed the stomach to be of the typical cascade type (Fig. 3). A subsequent examination, however, revealed a normal stomach (Fig. 4). Apparently the cascade stomach in this case was only a transient condition, caused by the pressure of a column of gas in the descending colon against the greater curvature.

DISCUSSION

From the description of these three cases it is apparent that the etiology of cascade stomach, as of hour-glass stomach, may vary widely. The condition may come from a malignant lesion, from a benign disturbance, or it may even be only temporary. The pressure of a distended descending colon against the greater curvature may produce cascade stomach, whether this distention be due to anatomic obstruction or to a temporary functional defect. With regard to age incidence, carcinoma is more likely to be the cause in older patients; but the etiological factor may still

* In regard to this type of cascade Kantor (in a personal communication) avers that in cancer of the lower esophagus or cardiac end of the stomach, gas accumulations under the left diaphragm are not uncommon. They are located: (1) in the stomach; (2) in the splenic flexure of the colon. Their origin is probably twofold: (1) because the diet is restricted to fluids and air is more readily swallowed; (2) the diet is more farinaceous than usual and intestinal fermentation is more common.

be malignancy in younger subjects, as in the case of lymphosarcoma intestinalis.

Roentgenologically, the appearance of the stomach in definite types of cascade stomach is alike, whether the cause be benign or malignant. Since the etiological factors in cascade stomach are so varied, further study to determine the underlying cause of this deformity is always required.

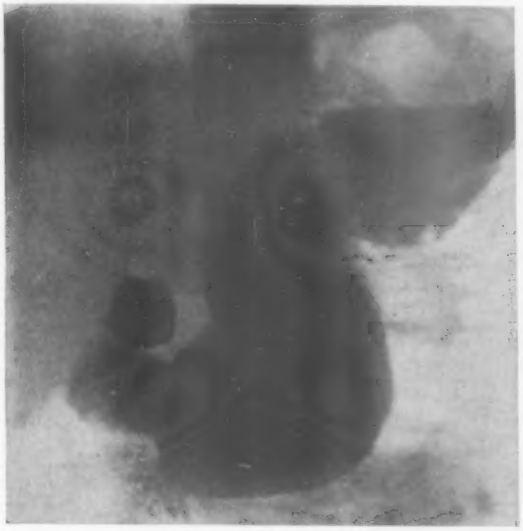

Fig. 3. Case III.

Cascade stomach must be differentiated from the other gastric deformities which are demonstrated roentgenologically. Hour-glass stomach, for example, is always a basic disturbance of intrinsic etiology, whereas cascade stomach may be either basic or symptomatic, arising from causes either inside or outside the stomach.

With reference to incisura of the stomach, Held and Roemer[2] drew attention to a rare form mentioned by Faulhaber.[2] In this condition the cardiac end of the stomach lying to the left is joined by a narrow isthmus to the rest of the stomach, which lies to the right. Held and Roemer believe that this deformity results from a continued regional and diffused spasticity, whether of intra- or extragastric origin. For example, ulcer of the lesser curvature may operate as an intragastric cause; whereas an enlarged spleen, gas in the splenic flexure or splenic portion of the transverse colon, or duodenal ulcer would be an extragastric cause. Held and Roemer cite a case in which duodenal ulcer caused cascade stomach.

A marked redundancy with hypertrophy of the splenic portion of the transverse colon and left hypernephroma are other causes of cascade stomach. A spastic condition in the transverse colon may also produce temporary cascade formation, as in the third case. Moreover, the deformity is sometimes found in cases in which there is no apparent explanation. In the case of hour-glass stomach, the shape of the deformity depends on the site of the constriction and the degree of its extension into the stomach wall. Cicatrization of a callous ulcer may give rise to marked spasticity, which usually occurs in the midsection of the vertical part of the gastric pathway. The result is that an upper and a lower sac with a connecting bridge are produced. The closer the constriction is to the pylorus the more likely is the hour-glass deformity produced thereby to be atypical in its contour.

Fig. 4. Case III.

Rieder, Faulhaber and Groedel describe an atypical form of hour-glass stomach, which Rieder termed "cascade stomach." The mode of production of this deformity was as follows: As a result of cicatricial traction of an ulcer situated high up in the fundus, the stomach was divided into two portions lying alongside of each other. The upper part, which received the esophageal opening, was situated to the left of the lower part. It was found that the opaque meal first filled the left or cardiac portion and, after a certain level had been reached, cascaded over this pouch so as to fill the pyloric sac. Operation in this case revealed extensive adhesions between the liver and the stomach.

Schütze believes that true cascade stomach produced by pathological transformations is not so rare as is generally supposed and states that he observed from 30 to 40 such cases. Laurell,[1] discussing this article, expresses the belief that Schütze is right, if we include under this heading all cases with cascade stomach, but that Schütze probably included in his series cases in which the cascade stomach was only an anomaly, as is not infrequently found in healthy men with a wide lower thoracic aperture. He observed a case of cascade stomach in which no basic pathology was found at operation. Therefore he is of the opinion that the deformity is relatively common and may represent only a transitory anomaly. My third case would appear to be of this type.

Laurell distinguishes as follows between the transitory forms and the true cascade stomach of pathological significance:

I. Cascade stomach without pathological significance.
   A. Normal cascade stomach form.
   B. Cascade stomach form produced by gas-filled colon.
      1. Through pressure (riding cascade stomach)
      2. Through traction (traction of mesocolon)

II. Casade stomach with pathological significance.
   A. Genuine cascade stomach caused by gastric ulcer with cicatricial or cord formation.
   B. Cascade stomach due to carcinoma.

SUMMARY AND CONCLUSIONS

1. Three cases of cascade stomach are reported, two of which were of malignant and one of benign origin.

2. The etiology of cascade stomach is varied and the underlying cause in individual cases must always be sought.

3. Some cases of cascade stomach have great pathological significance; others probably represent anomalies. It is of great importance to make the distinction.

4. Cascade stomach due to traction or pressure of the distended colon (riding cascade stomach) is as a rule easily recognized.

5. In hour-glass stomach the two sacs lie vertically one above the other. This is not the case in cascade stomach.

6. The identification of the form of cascade stomach is made by roentgenologic examination with the opaque meal. The determination of its underlying cause requires a comprehensive clinical investigation.

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Vol. XXII, No. 5

EXTRINSIC DEFECTS OF THE GASTROINTESTINAL TRACT*

REPORT OF CASES

BY D. Y. KEITH, M.D.

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A REPORT of conditions found roentgenologically in the abdominal cavity seems warranted when such findings are relatively rare. The following cases are presented in the hope that diagnosis of unusual abdominal lesions may be facilitated.

The cases are: Case I. Fluid contents in the lesser omental cavity from a slow leak in the gall-bladder. Case II. Fluid contents in the lesser omental cavity from a rupture of a malignant ulcer on the lesser curvature of the stomach. Case III. A hemorrhagic cyst of the greater omentum. Case IV. Multiple tumors in the postperitoneal region clinically diagnosed as lymphosarcoma.

In the roentgenologic literature at my command no lesion of the lesser peritoneal cavity could be found in which a diagnosis had been ventured from a roentgen examination with or without an opaque meal.

J. G. Sherrill in his recent book on "The Peritoneum" says: "The lesser peritoneal cavity often receives escaping contents from the perforation of a gastric ulcer upon the posterior surface of the stomach. It may also be filled with a bloody fluid or pus from an acute or suppurative pancreatitis." Sherrill in a personal communication states that no record of a roentgen visualization of any lesion of the lesser peritoneal cavity was encountered, nor was he able to find any reported case where bile was present in the lesser peritoneal cavity at operation such as was found in one of our cases.

Finding no record in the roentgen literature of lesions of the lesser peritoneal cavity, we thought some information might be gained by filling a normal lesser peritoneal cavity with an opaque medium to see what shape the shadow would assume. Considerable difficulty was experienced in obtaining a specimen for study. In patients who had lost much weight, the walls of the lesser cavity were so thin that the least pressure caused a rupture and the experiment was of no value. The films here presented were made of a man, aged fifty, who had died a few hours before from cerebral hemorrhage. He was apparently in good health, showing no evidence of any loss of weight and no abdominal scars from operation, so we may assume that the abdominal cavity was normal.

The abdomen was opened by a midline incision and a tube stitched in the lesser peritoneal cavity, after which air was introduced into the cavity and no leak was observed. A barium water solution was then introduced and films were made after injection of 100, 200, 300, 500, 800 and 1200 c.c. of fluid respectively (see Figs. 1, 2 and 3). The shadows shown conform very closely to descriptions given of the lesser peritoneal cavity in the latest edition of Cunningham's Anatomy.

Abscesses in the lesser peritoneal cavity may find their source in rupture of either the stomach or duodenum or from a rupture of the gall-bladder. Such an abscess, associated with the closure of the foramen of Winslow, may exist for some time and eventually become sterile. It may point in the loin or it may cause the formation of adhesions between the lesser omentum and the abdominal wall, and rupture at the umbilicus. Pancreatic cysts, or fluid in the lesser peritoneal cavity may push forward above or below the stomach or below the colon.

Case I. *Fluid in the lesser omental cavity from a slow leak in the gall-bladder.* In this case the foramen of Winslow had evidently been closed by adhesions following an operation eleven years previously for the removal of gallstones, at which time the gall-bladder was drained. The patient was free of symptoms for eleven years. From the history a leak of the

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

gall-bladder into the lesser peritoneal cavity had evidently occurred producing an abdominal tumor in the upper left quadrant. The patient had suffered two subacute attacks of pain localized to the upper abdomen. Six weeks later a diagnosis of malignancy in the upper left quadrant was made and the patient was referred to me for treatment. The lesser peritoneal cavity was distended with a thin bile-stained fluid, presenting an extrinsic defect in the midportion of the greater curvature of the stomach. The fluid had pushed through and presented a tumor below the greater curvature of the stomach. A direct microscopical examination showed many pus cells and cell debris. Cultures upon glucose, broth and blood agar showed no growth after five days. A subculture into plain agar from glucose broth showed no growth after two days' incubation at 37.5°C.

FIG. 1.

FIG. 2.

FIGS. 1 and 2. Lesser peritoneal cavity injected with 300 c.c. barium water solution.

FIG. 3. Lesser peritoneal cavity injected with 800 c.c. barium water solution. Note leakage of barium along right lateral abdominal wall with distention of the peritoneal sac beneath the spleen and gastric areas.

Mrs. H. J., aged fifty-four, married, has 5 children living. One died at birth; one died of typhoid fever. Grandfather died of cancer; no other malignancy in family. Operation for gallstones eleven years ago; gall-bladder drained; recovery complete.

Present Illness. Five weeks before admission to the hospital she was seized shortly after breakfast, with sudden pain in the epigastric region, which gradually increased in severity, followed by vomiting one hour after onset of pain. Relief of pain was experienced after vomiting. A physician was not called. Five days later, at 11.30 P.M., a second attack of severe pain in the left epigastrium occurred,

much more severe than the first attack. Vomiting occurred a few minutes after onset of pain. Severe pain lasted thirty minutes until a hypodermic of morphine was given by her physician. Pain radiated to each side of the abdomen and to the heart. She remained in bed ten days, on liquid diet, and experienced no further severe pain. Nausea was severe for a few days followed by a mild nausea lasting several days. Anorexia was present for ten days followed by rapid improvement.

Patient thinks she had fullness in the left side before onset of the second attack. Since the last attack the fullness has become more prominent and firm.

Physical examination revealed a well-developed, well-nourished, gray-haired woman. In the upper left abdomen there was a symmetrical, fairly firm tumor, oblong in shape, the size of a large cocoanut, estimated to be 10 cm. in diameter and slightly tender on firm pressure.

Blood count: Red cells, 4,940,000; white cells, 12,000; polymorphonuclears, 77 per cent; hemoglobin, 90 per cent. Urinalysis: A few oxylate crystals, a few white cells, and squamous epithelial cells; reaction amphoteric.

Roentgen examination with opaque meal showed a large, smooth filling defect in the midportion of the greater curvature of the stomach. The defect was smooth at its margins, presenting no "rat-eaten" irregularity such as is characteristic of malignancy of the gastrointestinal tract. The duodenal bulb was normal. The colon was examined by barium enema and was negative. Our impression was that an extrinsic lesion of the greater curvature of the stomach was present, origin not determined.

Operative Notes. Left rectus incision over center of the tumor mass. The mass was retrogastric, bile-stained fluid was aspirated. A small rubber tube was sutured into the tumor sac. One quart of fluid was evacuated. Recovery was uneventful.

Roentgen examination of the stomach, partially filled, two weeks after operation showed a defect suggesting a gastric ulcer on the lesser curvature near the midportion. As two years have elapsed with no ulcer symptoms it appears that no ulcer was present.

Case II. *Fluid contents in the lesser omental cavity from a rupture of a malignant ulcer on the lesser curvature of the stomach.*

Pancreatic cysts are frequently recognized by the characteristic way the lesser curvature is lengthened, with gastric displacement downward and to the left. The case presented shows these characteristic changes and in addition shows a definite extrinsic gastric defect in the midportion of the opaque media in the stomach.

The splenic flexure of the colon is also displaced directly downward, the tumor showing above this structure and well below the shadow of the left kidney, which appears normal.

At operation the lesser peritoneal cavity was found to be filled with blood and encephaloid material so thick that aspiration was difficult. Two small, milk white nodules were present on the anterior gastric wall near the center of the lesser gastric curvature. A microscopical study revealed adenocarcinoma; apparently the origin was the lesser gastric curvature. It is quite certain a rupture with transplantation of carcinoma cells into the lesser peritoneal cavity had occurred.

The patient, a white male, aged seventy-seven, came in complaining of weakness, loss of weight and gastric distress for the past six months. His family history was unimportant. He stated that for fifteen years he had had attacks when he became weak and hungry, usually followed by profuse perspiration. These were usually relieved by food and belching. During the eighteen months before admission he had been troubled by discomfort in the epigastric region and eructations of gas at times. His present illness extended over the past six months, and was characterized by a loss of 20 pounds in weight, loss of strength and discomfort after eating. The use of calomel was said to have given rather long periods of relief from symptoms.

Case III. *A hemorrhagic cyst of the greater omentum.*

Omental cysts are rare if one is to judge by the number of cases reported in current literature, or referred to in textbooks. There are no definite symptoms by which they may be diagnosed. The roentgenogram may be of diagnostic aid if the cyst is dermoid in origin and contains bone or opaque material.

Our case was in a child two years of age. The cyst was multilocular and contained thin, bright red fluid. The primary film revealed the usual appearance seen in general ascites, giving the im-

pression of a poor film, due to fluid absorption of the rays.

With an opaque enema the transverse colon was seen displaced upward and showed deformity that was apparently extrinsic. No irregularity could be seen. The descending colon appeared pulled towards the median line. The ascending colon and cecum did not fill. These changes are not seen in a simple ascites and the deformity should help one to suspect omental cyst. The changes seen here are entirely different from the changes seen in a retroperitoneal neoplasm, where, as a rule, the ascending and descending colon are displaced to the external part of the abdominal cavity.

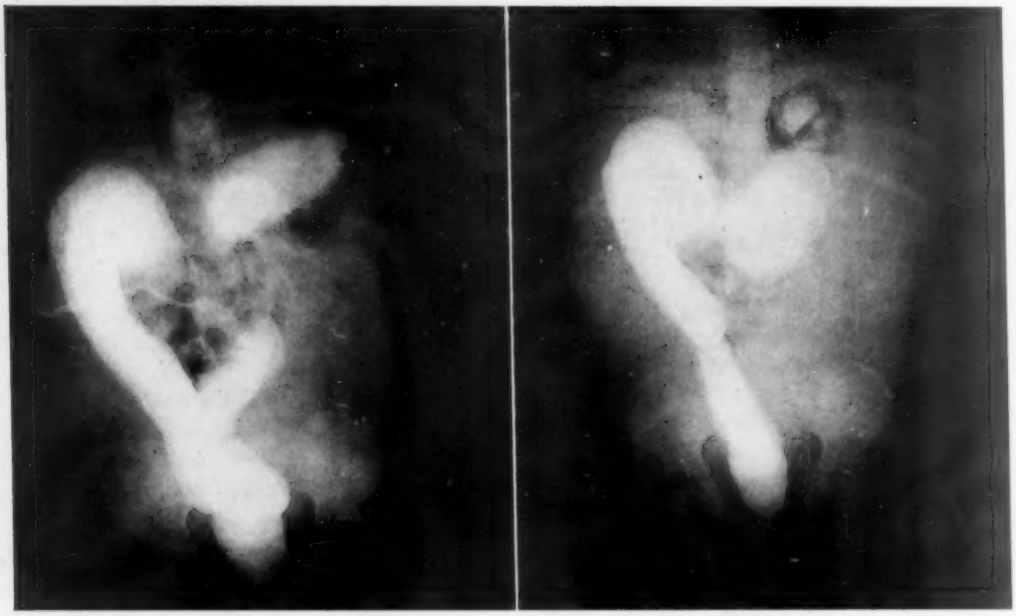

FIG. 4. FIG. 5.

FIGS. 4 and 5. Omental cyst. Note distortion of barium in the transverse colon and evidence of cyst shadow.

Patient, G. L., Jr., aged two. Both parents living and in good health, father was very robust and presented an unusual degree of prominence in the midepigastric area. He stated that his father, the child's grandfather, was of the same build. The patient, since birth, had always presented a prominent epigastrium. He was a very robust, sturdy child for two years of age.

Present Illness. The onset was sudden, the abdomen had increased rapidly in size with pain present for one day, which gradually increased in severity, with abdominal distention of fluid character. When an enema was given it was only partially received and retained with difficulty.

Physical examination showed a well-developed robust child, abdomen greatly distended, apparently with fluid. No masses or local tenderness could be elicited. The appearance of the soft tissues of the abdomen was that of a general ascites.

FIG. 6. Photograph of omental cyst after removal.

A primary film of the abdomen was negative. However the film was poor since the abdomen was waterlogged. The first barium enema was unsuccessful. This was followed by a water enema. A reëxamination by opaque enema was made three hours later which revealed a filling defect in the transverse colon, apparently extrinsic (Fig. 4). The descending colon showed no deformity. The

ascending colon and cecum did not fill completely. A film, after evacuation, still revealed deformity in the transverse colon (Fig. 5). This portion was never seen filled at either roentgenoscopic or plate examination.

A paracentesis abdominalis was done, obtaining a thin bloody fluid. A small rubber catheter was threaded through the trocar and the fluid was allowed to evacuate slowly. The baby was comfortable for twenty-four hours. On the day following the tube became occluded and was removed. The abdomen was quickly refilled with fluid (thirty-six hours).

Operative Notes. The abdomen was opened by a long median incision and free thin bloody fluid was encountered in the peritoneal cavity. Many multilocular cysts of the omentum were found and were removed by transfixing and ligation at the most dependent points near the transverse colon. The microscopical report was simple cyst, with hemorrhagic and chronic inflammatory reaction.

The cysts were filled with water after removal and suspended for photographic record (Fig. 6).

Recovery was rapid. The patient was heard from September 20, 1928, eighteen months after operation, and was in perfect health. No physical or roentgen examination has been made since he left the hospital.

Case IV. *Multiple tumors in the postperitoneal region clinically diagnosed as lymphosarcoma.*

Solid postperitoneal neoplasms rarely show enough contrast to be recognized upon a roentgen film, but should always be thought of as a first diagnosis when the colon is filled with non-opaque material and shows displacement to the external lateral walls of the abdominal cavity. Even in distortion of the colon, with little or no displacement, one should suspect a postperitoneal neoplasm.

The case reported showed multiple neoplasm on the primary film. The opaque enema showed the descending colon displaced to the external lateral abdominal wall and again showed the areas of different density representing the neoplasm. The shadows of the neoplasm were slightly oval in shape, multiple in number, showing no evidence of calcification. The neoplasms were from 1 to 2 cm. in diameter.

Mr. S., aged forty. Patient has always been very healthy, having experienced no illness prior to the present attack. Two months previous to the examination he had an attack of obstipation lasting five days, with gradually increasing distention of the gastrointestinal tract. On the fifth day considerable pain was experienced as he had been taking enemas and purgatives during the five days the obstipation was present, without results until the fifth day. After two or three copious bowel movements he was entirely comfortable and resumed his usual duties. Another similar attack of lesser severity was experienced one month later. His loss of weight was 20 pounds.

Examination showed a well-developed robust man, weight 230 pounds. Examination of the abdomen by inspection, percussion and palpation revealed one or two dense masses in the lower left abdomen.

The primary film revealed many nodular areas of increased density to each lateral side of the lumbar spine. The larger ones were on the left side of lumbar spine. Examination of the colon by opaque enema, under roentgenoscopic control, was negative for delay or obstruction in the big gut. The descending colon occupied an extreme external lateral position in the abdominal cavity.

A film made with the Bucky diaphragm verified the position of the colon; also the nodular masses on either side of the lumbar spine were more prominent by contrast with the opaque fluid in the colon. Clinical diagnosis was lymphosarcoma of the retroperitoneal lymph nodes.

High voltage roentgen therapy was applied through anterior and posterior ports. Following the first series he continued to lose weight. At the end of six weeks his weight was only 185 pounds, a loss of 65 pounds since the first attack of obstipation. Another series of high voltage roentgen therapy was given and his gain has since been gradual. Eighteen and a half months have elapsed since his first treatment was given. He was last heard from September 18, 1928, at which time he was in good health. A recurrence is to be expected.

CONCLUSIONS

1. With close cooperation of the clinician, the surgeon and the roentgenologist, the location and frequently the origin of many obscure lesions of the abdominal cavity may be determined.

2. A roentgen examination should be made on every rare, as well as every chronic, abdominal case in which a positive diagnosis cannot be determined with the usual careful physical examination. A

careful history and physical examination of the abdomen by the roentgenologist prior to the roentgen examination may prove of invaluable assistance.

3. A careful study of films made in anteroposterior, posteroanterior, lateral and lateral-oblique positions, may give information as a group, where a single film presents only suggestive shadows.

4. In selected cases pneumoperitoneum may be of additional aid in arriving at a diagnosis.

"SPOTTED BONES"

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SOME authors believe this condition to be more common than is generally supposed, but the unusual appearance of the bones could hardly escape observation in the ordinary roentgenogram.

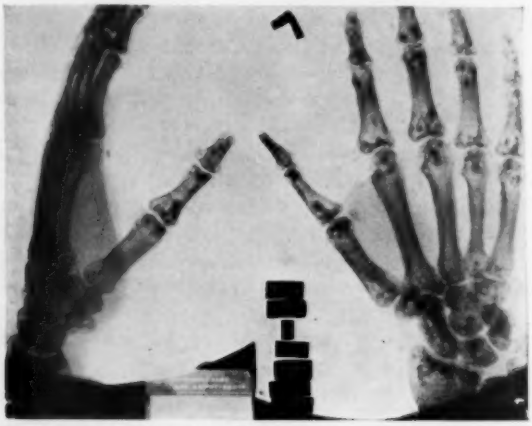

FIG. 1. Attention is called to the areas in the cortex extending downward into cancellous tissue. Compare with Figure 6.

The title, "L'Osteopoecilie, a new form of generalized condensation of the bones without clinical symptoms" given by Ledoux-Lebard in his report of a case may give the leading clue as to why it is not more often seen.

The condition is symptomless, hence the only cases thus far reported have come to notice while being examined for some other trouble entirely different from any suspected bone change. This fact is also true of many other bone changes, more especially those due to some constitutional disturbance.

Voorhoeve has made an exhaustive study of this and allied conditions and reports a case of a boy fourteen years of age, presenting longitudinal striation in the long bones and the pelvis, and summarizes as follows:

FIG. 2. No bone changes demonstrated.

"A description of a roentgenological picture hitherto not described, of a systemic disease of the skeleton (cf. the detailed summary at the foot of the first chapter).

"This disease should be referred to the dyschondroplasia group.

"Osteopoecilia or osteopathia condensans disseminata and the cases here described are two manifestations or phases of the one and the same process. Both of them should be classed among the dyschondroplasia group."

Albers-Schönberg was the first to report a case of osteopoecilia before a medical gathering in 1915. The patient was a young soldier, aged twenty-two. A year or so later Ledoux-Lebard reported a

case occurring in a young man, also a soldier, aged twenty-eight, and not having heard of Albers-Schönberg's report,

Fig. 3. Note the bone changes in the humeral head.

dition in comparison with the other cases was not exactly the same. The character and distribution of the spots in the bones

Fig. 4. Attention is called to the absence of the spots in the shaft.

suggested the name "osteopoecilia," adopted from the Greek word ποικιλος —spotted.

Shéle in 1922 examined a medical student, thirty-four years of age, for fracture and found this unusual condition. He made an exhaustive study of the patient's general health and condition. His conclusions are interesting: "To start speculating as to the nature and cause of these changes in structure would simply be to plunge into the wide field of guessing."

The 3 cases just cited and the present one here reported resemble one another in several respects. The roentgenograms are so similar that they seem to have been made from the same case. The location of these changes in the bone structure exactly follows the chart given by Moreau. They were men in adult life who had good previous health records and were examined for injury.

In 2 other case reports the roentgenograms were either poor or else the conditions were different, and in these two instances the patient's previous health records were bad. The bone changes here in all probability might be due to some malnutrition, as is often seen in constitutional diseases.

Coon reports a case somewhat similar to that of Voorhoeve, and while some authors believe osteopoecilia to be rather common certainly distinct types are rarely seen.

In the following case the areas agree with the chart of Moreau.

W. C., aged fifty, reported at the hospital on June 17, 1925, for a supposed fracture of one or more bones of the hand. Fracture did not exist but this unusual condition of the bones of the hand was found, and thinking it might be a local condition his other hand was examined and found to present the same appearance. Then the feet, long bones, trunk and head were examined in the order mentioned.

The man was born in Ireland but had spent most of his life in the United States. He had worked in a leather store. His weight was about 160 pounds and he was 5 ft. 9 in. in height. He was of the blond type, rather florid,

well nourished, with hands, arms and body generally well formed. Married and has two healthy children.

FIG. 5. Attention is called to the pelvic bones and to the bodies of the spine.

His family history was negative, his mother having died of old age and the father of paralysis. A brother and sister are living, two brothers having died in infancy. He does not remember about diseases of childhood and except for an attack of grippe has never been sick. He is in perfect health, does not suffer from indigestion or constipation. Teeth are in good condition. Smokes and chews tobacco. Drinks moderately though he has been drunk. Blood Wassermann was negative and blood count normal. It was desired to study his calcium but being, as he said, perfectly well he could not grasp the situation and declined further study.

The condition seen upon the roentgenograms may be described as a number of consolidated areas that vary in size from 1 to 5 mm. Upon first examination these areas appear to be round, with well-defined borders, but upon closer examination, they prove to be irregular in shape, as well as in structure. These areas are found in the cancellous structure of the bone, the base usually being on the inner edge of the cortex, and the greatest amount of density being at the apex. In other words, they appear to be an exostosis extending into the bone substance rather than outward. These areas are confined to the spongy bones such as the carpus and tarsus, more or less scattered through the phalanges at the ends of the long bones, in the bodies of the vertebrae, but not in the bones of the head. In the pelvis they are confined to the ischium, pubis and sacrum, the upper portion being free (Figs. 1 to 6).

A second series of plates, made four years later, showed no change in the character of the bones.

FIG. 6. Compare the changes observed in the bones of the foot with those demonstrated in the wrist and hand (Fig. 1).

COMMENT

Osteopoecilia or osteopathia condensans disseminata must be rare. From the fact that it is symptomless, its discovery is accidental.

Exostoses are usually without symptoms, but the irregular tumor felt upon the bone usually leads to investigation. This is true of most developmental bone conditions; they may be painless, but usually there is some deformity which causes annoyance. Again like other bone troubles its pathology is unknown; so far even heredity cannot be suggested. It evidently must be associated with some change in certain cartilaginous structure in early life, its distribution being confined to that portion of bone. Unlike exostosis it does not appear upon the shafts of the long bones or upon the head.

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CONGENITAL ESOPHAGEAL ATRESIA

BY EDWARD C. VOGT, M.D.

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IF congenital esophageal atresia were as rare as it is fatal we would as yet be unable to find the first recorded instance. Six cases of this apparently hopeless condition were admitted to the Infant's Hospital between September, 1925 and December, 1928, or an average of about two a year where the annual admissions total approximately 850. Five of these are listed under surgical mortalities following gastrostomies. The sixth was in such poor condition when first seen that operation was not undertaken and the baby died the following day.

Since the majority of these infants are entirely normal in other respects it is hoped that some ingenious surgeon will eventually devise a cure.

Petersen[1] reported success in a girl aged seventeen years, suffering from congenital esophageal stenosis by transplanting a loop of small intestine. If by means of a gastrostomy the patient could be carried along till the time when so serious a procedure could be withstood, certain of the atresias might also be cured. Before any operation is undertaken an attempt should be made to recognize the true nature of the individual case, for it is obviously futile to do a simple gastrostomy if food or stomach material has free access to the lungs.

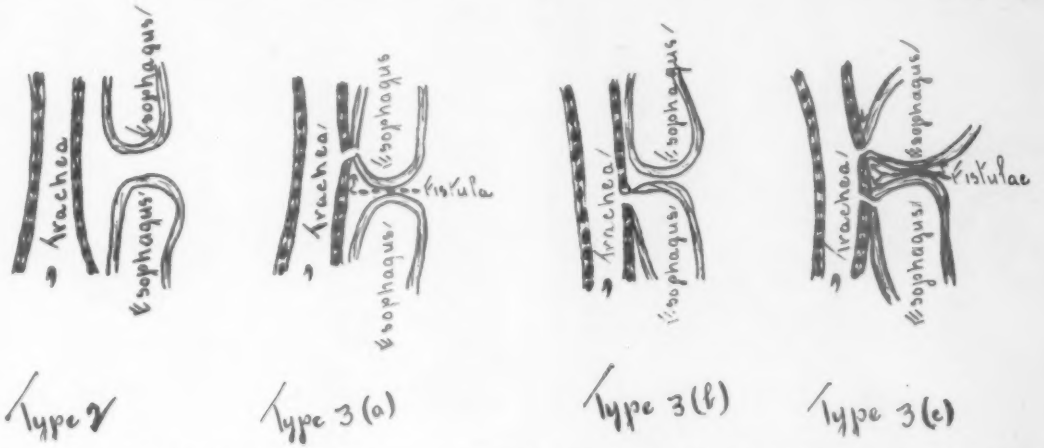

FIG. 1. Diagrammatic sketches to show types of atresia. Type 1 in which there is a congenital absence of the esophagus is not shown.

Types of atresia (see Fig. 1).

1. Complete absence of the esophagus. This type is rare.[2]

2. Cases in which there is an upper and a lower segment each ending in a blind pouch.

3. Cases with fistulae communicating between the esophageal segments and the trachea or bronchi.

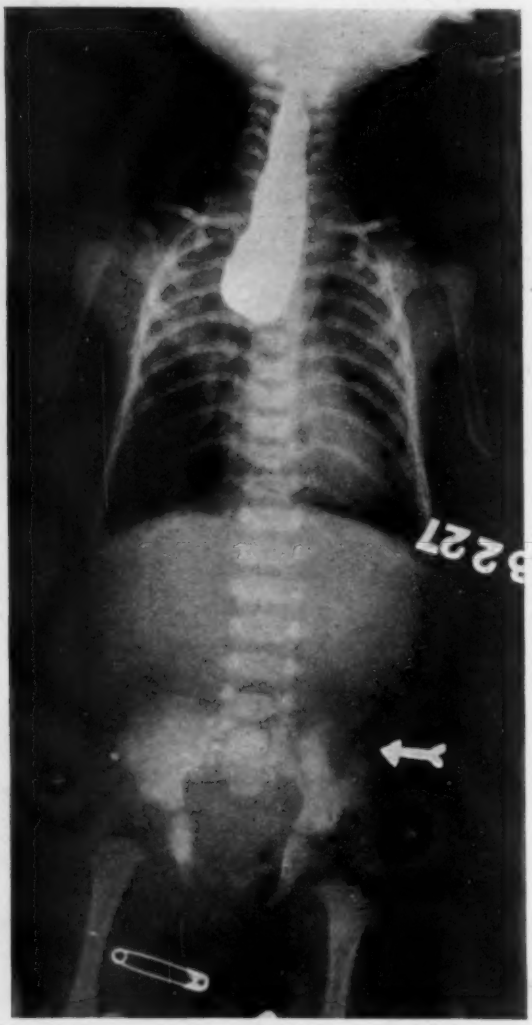

Fig. 2. Type 2 atresia. There is no air in the stomach or small intestines. The small bubbles of air in the descending colon were introduced with rectal clysis.

(*a*) With fistula between the upper segment and trachea.

(*b*) With fistula between the lower segment and trachea or bronchus.

(*c*) With fistulae between both the segments and the air passages.

Clinically the condition should be suspected in any new-born infant that persistently vomits immediately after feeding. If a tube is passed it usually meets an obstruction about midway of the esophagus. This does not necessarily denote a complete atresia for there are cases of incomplete stenosis which do not allow the passage of even a small catheter. Neither will the tube reveal the type being dealt with.

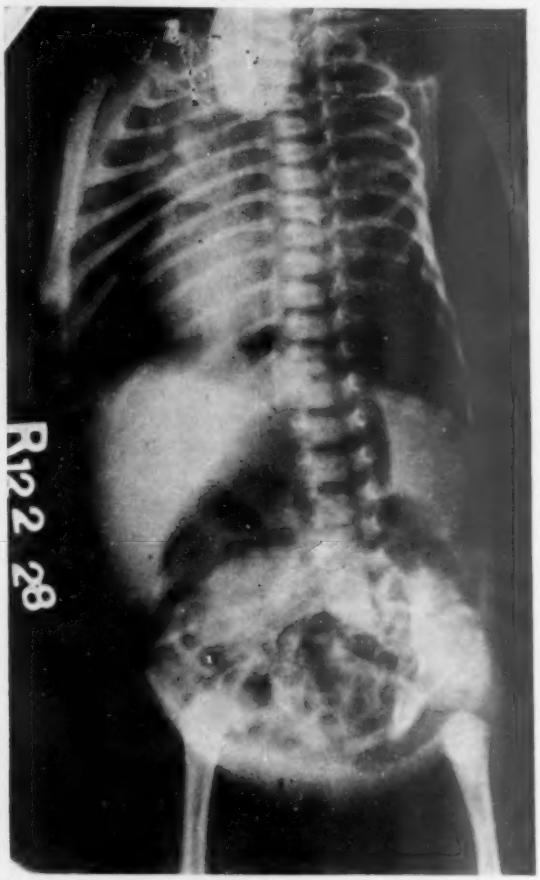

Fig. 3. Type 3(*b*) atresia showing complete obstruction of the upper esophageal segment. Air in the stomach and intestines denotes a connection between the lower segment and the trachea or bronchus.

Roentgenological Findings.

In Types 1, 2, and 3(*a*) there will be no gas in the stomach or intestines, providing none has been injected per rectum. In Types 3(*b*) and 3(*c*) there is usually a large amount of gas in the gastrointestinal tract. When the infant is given bariumized milk by bottle or tube the following distinguishing features may be observed: Type 1 (not seen in this series) would show an obstruction high up. Type 2 shows a blind pouch

beyond which no barium will pass (Fig. 2). Type 3(*a*) is somewhat more difficult to differentiate, but if observed carefully with the roentgenoscope a small amount of barium may be seen passing from the esophageal pouch through the fistula into the trachea. The patient is immediately thrown into a fit of coughing and strangling, and a subsequent film shows flecks of barium in the smaller bronchi. Care should be taken that some of the barium does not overflow the esophageal pouch and reach the trachea and bronchi by way of the glottis. Type 3(*b*) shows a large amount of air in the stomach and intestines but when barium is given by mouth complete obstruction of the upper esophageal segment is noted (Fig. 3). Type 3(*c*) gives a combination of the findings of 3(*a*) and 3(*b*), namely, air in the stomach, an upper pouch from which a small amount of barium may get into the bronchi which is followed by coughing and strangling (Fig. 4).

The first two types seem to offer the most hope for successful surgical interference since with the third group insufflation pneumonia is practically sure to result.

Two of the 6 cases included in this report lived ten days. The average length of life was seven days.

Post-mortem examinations were obtained on all. Only one showed any gross anomaly other than the esophageal atresia, namely, congenital stenosis of both ureters. Two were of the Type 2 atresia, one was Type 3(*a*), one Type 3(*b*) and two Type 3(*c*). The immediate causes of death were pneumonia, dehydration and inanition.

CONCLUSIONS

Congenital esophageal atresia has up to the present been 100 per cent fatal.

If surgery is to be of any real value it is important to recognize the type of atresia.

FIG. 4. Type 3(*c*) atresia. Air in the stomach and flecks of barium in the bronchi denote fistulae between both esophageal segments and the air passages. (In this case both fistulae communicated with the trachea.)

Roentgen-ray examination is most valuable in diagnosis and differentiation.

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THE AZYGOS LOBE OF THE LUNG*

BY E. GORDON STOLOFF, M.D.

NEW YORK CITY

IN 1923 Wessler and Jaches[6] described for the first time in the literature a peculiar shadow which they observed invariably on the right side of the chest in the region of the upper lobe. This appears as a very fine line with its convexity lateral coursing from the apex of the lung downward, slightly outward and then inward and medially to approach the mediastinum at about the level of the second costal cartilage. Here it ends as a small dense shadow usually about the size of a pea, which may be shaped like a comma or coffee bean or an elongated diamond. At the apex there may be a slight depression. Its distance from the midline varies so that it may lie close to the mediastinum or extend as far as the mid-apical line. Wessler and Jaches assumed that this was due to some congenital anomaly of anatomic structure, the nature of which was not clear. Velde[5] in describing this shadow four years later suggested that it might be due to an accessory or so-called azygos lobe of the lung, but had no autopsy confirmation.

Hjelm and Hultén[2] have also accepted the interpretation of this shadow as representing the outlines of the azygos lobe. Recently Bendick and Wessler,[1] who in an experience of fifteen years have observed approximately 50 such instances, reported 2 cases in which the nature of this process was confirmed at autopsy. Mather and Coope,[3] in a review of 3000 chest films, found 4 in which the outline of the azygos lobe was visible.

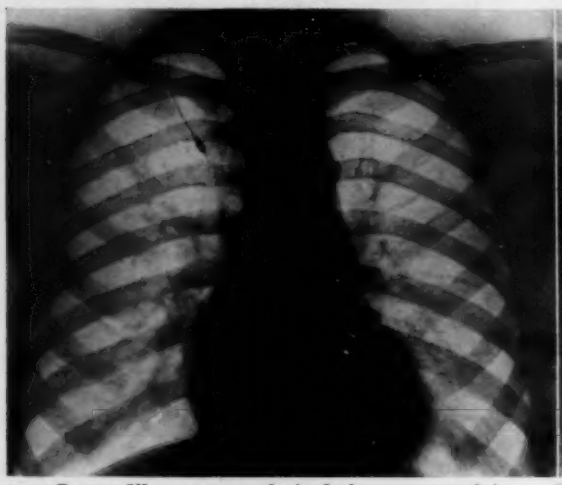

FIG. 1. Case I. Illustrates a relatively large azygos lobe. The fissure is seen extending well into the apex so that the lobe includes most of the apex. The point of union of the azygos vein with the superior vena cava is represented as an elongated, narrow, diamond-shaped shadow in the region of the fourth dorsal vertebra. The child, a seven year old boy, was examined for a suspected cardiac lesion. (Retouched.)

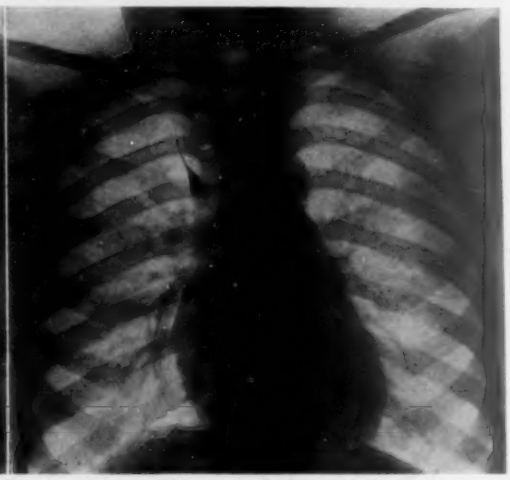

FIG. 2. Case II. Shows a narrow lobe limited to a small medial part of the upper lobe. The boy, aged ten, was examined for a fractured rib. (Retouched.)

Since the first anatomic description by Wrisberg in 1777, anatomists have reported 24 cases (Mather and Coope). The azygos lobe is recognized as due to persistence of the fetal position of the azygos vein. The vein lies lateral to the spine and in its passage from the posterior chest wall to its point of entrance in the superior vena cava, it traverses the substance of the right upper lobe. In doing so it carries with it a reflection of the parietal pleura and this persists as a thin membrane occupying a fissure between the azygos (or accessory) lobe and the remainder of the upper lobe.

*From the Departments of Pediatrics and Radiology, Mount Sinai Hospital, New York City.

The vein occupies the lower part of the fissure which is represented by the fine shadow described above. The denser shadow at its mesial end is caused by the confluence of the azygos vein with the superior vena cava. As indicated by the varying position of the outline, the azygos lobe may be so small as to be concealed by the large vessels or may be large enough to extend well beyond the mid-apical line. While experience at the Mount Sinai Hospital indicates a decided infrequency of this appearance roentgenologically, it is not without clinical significance since the azygos lobe may become the seat of pathology similar to that in other parts of the lung tissue. It is supplied by a small branch of eparterial bronchus. Bendick and Wessler report a case of chronic disease of the lobe; another of pleural effusion of the fissure, and one of thickening of the azygos

Fig. 3. Case III. Shows a very small lobe. The direct continuity of the azygos vein with the superior vena cava in its entrance may be seen. The patient, a boy aged nine, was a cardiac suspect. (Retouched.)

Fig. 4. Case IV. Illustrates a pleural thickening over the azygos lobe which is continuous with a similar process over the right apex. The patient is a boy seven years old who has a history of "lung disease." (Retouched.)

Fig. 5. Case V. Shows an azygos lobe which occupies the medial half of the apex. The point of union of the azygos vein and the superior vena cava is represented as an elongated, narrow, more or less trapezoid-shaped shadow. There is a faint pleural thickening over the azygos lobe. This patient is a girl, aged twelve, suffering from malnutrition, possibly on a tuberculous basis. (Retouched.)

Fig. 6. Case VI. Shows an azygos lobe occupying the medial half of the apex. The point of venous union is seen immediately adjacent to the vertebrae. This patient, a boy aged nine, is recovering from a respiratory infection. (Retouched.)

fissure. Müller[4] describes a case in which the bronchus was narrowed by the pressure of the azygos vein, and diffuse fibrosis and multiple dilatations of the lobe were present.

Herewith are shown 6 cases of azygos lobe in children. This is significant because superior mediastinal widenings in children are frequent and demand careful interpretations.

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RIGHT UNILATERAL FUSED PELVIC KIDNEY COMPLICATING A CHRONIC APPENDICITIS

BY FRANCIS W. CURRIN, M.D.

BROOKLYN, NEW YORK

THE following case presents an unusual feature which I believe warrants being reported.

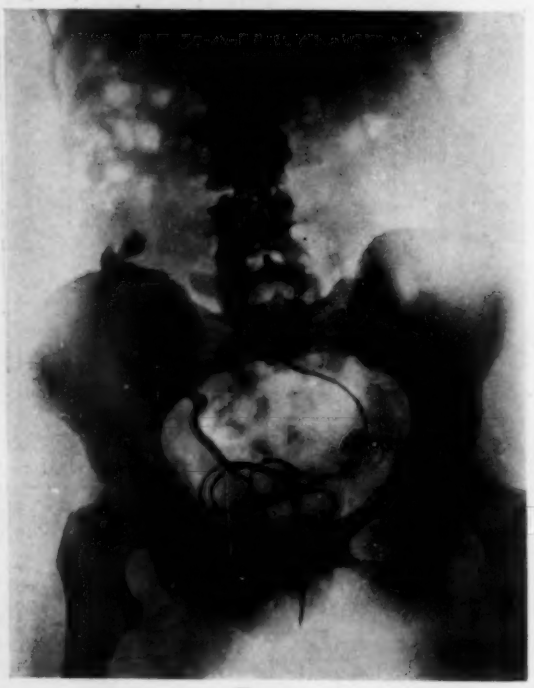

Fig. 1.

Mary N., aged twenty-three, white, Italian.
Family History. Of no importance.
Personal History. Complained of gaseous eructations after heavy meal; otherwise unimportant.

Chief Complaints. Weakness, pain and mass in right lower quadrant. Patient claimed that the pain in the right lower quadrant came on during pregnancy (one and one-half years previously). Pain came on suddenly, localized in right lower quadrant, which gradually subsided into a dull pain, which has been present ever since. This pain was increased by hard work, but eased on reclining.

The mass in right lower quadrant was noticed one week before admission to the hospital. It was fixed, not movable and had not increased in size. Patient claimed she had lost some weight, tired easily and had an occasional cough. The physical examination was negative except for a mass in the right lower quadrant tender on palpation and about the size of an egg.

A film of the abdomen at this time showed a shadow in the right lower quadrant suggesting a ptosed kidney. The left kidney was not visualized.

Film of the colon after an opaque enema showed a normal sigmoid, descending and transverse colon; the cecum and ascending colon were not filled by the opaque enema, and further study was advised.

The urine showed nothing pathological. She was then seen by the urologist, who stated that this mass might be a pelvic kidney, and advised a complete urological examination.

A cystoscopic examination was made the

following day, and an opaque salt allowed to flow by gravity into both ureters.

Roentgen examination showed that both ureters joined the bladder in their usual position. There is a shadow in the right lower quadrant which is apparently a kidney larger than the normal. This kidney has two pelves and is probably a fused kidney. Both pelves appear normal. Both ureters appear pulled to the right. The right ureter appears larger than the left (Fig. 1).

The diagnosis of the urologist was right unilateral fused pelvic kidney.

The surgeon, after this examination, decided to operate and remove the appendix. His decision was influenced by the fact that this kidney condition was congenital, while the attacks of pain had been present for only one and a half years.

At operation a chronically diseased appendix was removed. A mass lying retroperitoneally was found which was thought to be a fused kidney, but no attempt was made to examine it.

That the surgeon's decision was justified was proved by the fact that several months after operation, this woman is enjoying perfect health.*

*The writer wishes to thank Dr. Thomas Brennan for permission to report this case.

A CASE OF PSEUDOCYESIS

BY PHILIP H. COOK, M.D.

WORCESTER, MASSACHUSETTS

A VERY stout woman, aged thirty-nine, was seen Jan. 19. She had been married for fifteen years and had never been pregnant, although both she and her husband were very desirous of children. Menstruation had ceased five months before the date of examination; there had been no nausea nor vomiting. Physical examination showed no changes in the breasts. The patient thought she had felt motion, and pelvic examination disclosed a tumor which two physicians thought might be the enlarged uterus.

A roentgenogram in the prone position showed no evidence of a fetal skeleton. Anterior to the sacroiliac region was an oval area of high translucency, 11 × 15 cm. in size, with its long axis tilted slightly to the left. Its outline was very sharply demarcated (Fig. 1). This was believed to be a dilatation of some portion of the lower bowel, and an opaque enema was proposed, but was objected to by the patient's husband, who feared "it would weaken her." The diagnosis of pseudocyesis, with tumor from gaseous bowel distention, was made and conveyed to the patient, to her great disappointment. The family physician reported that menstruation was re-established soon after. The tumor gradually disappeared and a later roentgenogram, taken in April, disclosed only lower bowel of normal size.

FIG. 1.

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EDITORIAL

COCCIDIOIDAL GRANULOMA

AT the Twentieth Annual Meeting of the American Roentgen Ray Society held at Saratoga Springs, N. Y., in September, 1919, Bowman[1] read a paper on "Coccidioidal Granuloma" giving the first detailed roentgen studies on this unusual disease. This report was based upon a study of five cases. The disease he characterized as a "definite, acute, subacute or chronic disease due to an infection by a parasitic or mould-like growth called by Ophüls the Oidium Coccidioides. It is sometimes called the California disease owing to the fact that all of the cases reported, with but three exceptions, have either lived in or visited that State before contracting the disease. Not only have most of the cases lived there, but a large percentage of them have come from one district of the State, viz., the San Joaquin Valley." Whether or not this disease is peculiar to California Bowman was not willing to state but he was of the opinion, and this is shared by others, that it is not. He believed that it was probably prevalent throughout the country, but that it went unrecognized, masquerading under some form of tuberculosis which it simulates to a marked degree. That this conjecture was well founded subsequent events have proved and "although coccidioidal granuloma appears to be essentially a Western disease, infection has occurred in the Eastern and Midwestern states, and in South America, in persons who have never visited California."[2]

The historical development of our knowledge of this disease is interesting. The first reported case of which we have any knowledge was by Wernicke[3] of Buenos Aires in 1892. He recorded a unique instance of doubtful mycosis fungoides in which he found during life large numbers of undoubted protozoa in the cutaneous lesions. This case, though it attracted comparatively little attention, is in fact of the greatest interest as it represents one of the earliest reported cases of undoubted protozoan dermatitis to be found in the literature. This case was later reported in detail by Posadas.

The first case reported in this country was by Rixford of San Francisco, in 1894, and later a more detailed report of two cases was given by Rixford and Gilchrist[1] who stated at that time that the disease was due to a protozoa and suggested "protozoan" or "coccidioidal pseudotuberculosis" as a suitable name for the disease. In 1905 Ophuls[2] reported twelve cases, and from his study proved rather conclusively that this disease is not due to a protozoan infection, as was formerly believed, but to a pathogenic fungus, *Oidium coccidioides*, and he suggested the name "coccidioidal granuloma."

Other writers, notably MacNeal and Taylor[3] (1914), Dickson[4] (1915) and Taylor[5] (1923) reported additional cases calling attention to the nature of the disease, its probable mode of communication and especially to the prevalence of the disease in California and notably in one section of the state, the San Joaquin Valley.

All observers agree that coccidioidal granuloma is caused by a specific fungus, and affects chiefly adult males (usually laborers), though twenty-nine cases have been reported in women. It is a disease of both man and animals. The first case in

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animals was reported by Giltner[1] in 1918, who found the infection in bovine bronchial and mediastinal lymph glands from an animal slaughtered in San Diego, California.

Nothing definite is known of the natural habitat of the specific organism. "The infecting agent is evidently the spore which develops on the aerial hyphae of the mycelium of the fungus. So the first question would be, Where does the fungus develop primarily? In the laboratory it will grow on almost any kind of vegetable; hence, it is quite likely that the fungus can grow in nature on decaying vegetable material. It is probably the spores of the fungous growth that become mixed with dust and are then inhaled into the lungs." (Ophuls.[2]) The accumulated evidence seems to prove that the atrium of infection is primarily the upper respiratory tract. The primary lesions are usually either in the skin or in the lungs and the lesion in general can be classed under the head of infectious granulomata.

The initial skin lesions quite closely simulate the more acute forms of cutaneous tuberculosis, and may remain localized for several years. They may also have the appearance of the lesions of mycosis fungoides. Some cases with painless subcutaneous abscesses have occurred, while in others the picture has been that of glandular tuberculosis.

If the primary seat of infection is the lung, the symptoms are identical with those of tuberculosis, except that there is less tendency to cavitation than is usually seen in tuberculosis, and the differential diagnosis can only be determined by identifying the specific infective agent.

This disease is of particular interest to roentgenologists from the fact that it affects not only the skin but also the joints and the lungs, and would therefore be apt, sooner or later, to come under their observation. In Rixford's first description of the bone changes he called attention to the extensive destruction with formation of tubercle-like nodules containing large giant cells of the Langhans' type, and to the fact that the process both macroscopically and microscopically resembled genuine tuberculosis. It was noted, however, that the process seemed somewhat more acute than tuberculosis and that there was a tendency for the suppurative process to extend along the tendons and muscle sheaths to a considerable distance from the joint. The joint changes which Bowman observed roentgenographically were characterized by irregular areas of necrosis involving the articular surfaces, with a peculiar irregular fuzzy appearance of the periosteum of the shaft of the bone near the joint surface as the only distinguishing feature, and this is a fairly constant finding. If the examination of a patient points to a process which appears to be bone tuberculosis but which shows extensive periosteal proliferation associated with an acute destructive process somewhat atypical of tuberculosis, the possibility of its being a coccidioidal granulomatous process should be considered. While the roentgenogram is not in itself a means of differentiation, with the apparent definite increase in the incidence of the disease, the importance of the roentgen examination should not be overlooked as by an accumulation of knowledge a sufficient basis for differential diagnosis may be obtained.

It is also of interest to note that roentgen rays have been used, with considerable temporary benefit, in the treatment of this disease.

L. R.

[1] Giltner, L. T. The occurrence of coccidioidal granuloma in cattle. *J. Agric. Research*, 1918, xiv, 533.
[2] Ophuls, Wm. Discussion. *J. Am. M. Ass.*, 1929, xciii, 1055.

Subscribers to The American Journal of Roentgenology & Radium Therapy *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.
Thirty-first annual meeting: 1930, to be announced.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Detroit, Mich., 1930.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.
Annual meeting, Detroit, Mich., June 23–27, 1930.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Walter T. Bronson, Northwestern Univ. Med. School, Chicago, Ill.
Fifteenth annual session: New Royal York Hotel, Toronto, Canada, Dec. 2–6, 1929.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY
ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Missouri Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY
Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.
Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London W. 1.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Third session, Sydney, Sept. 2–7, 1929.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.

Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RONTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.

Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. O. Wissing, Copenhagen

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

REPORT OF COMMITTEE ON STANDARDIZATION OF ENCEPHALOGRAPHY

AMERICAN ROENTGEN RAY SOCIETY

It has been proved very definitely that encephalography is destined to become a lasting and widely used roentgenological diagnostic procedure. Like all other diag-

nostic methods with which we have to deal, it should be carried out in an exact manner based upon standardized principles. Proper interpretations should be possible by anyone familiar with the work. It should be capable of exact reproduction in order to detect changes from time to time just as we note alterations in lung lesions in pulmonary tuberculosis. It is true that a neurological surgeon or a neurologist skilled in the proper technique must perform the more important part in the operative procedure on his patients. In this way encephalography is analogous to urography.

Encephalography in the past has occupied a unique position in roentgenological diagnosis for the reason that the neurological surgeon is the one who has been making the interpretations based upon widely different methods of technique in the introduction of air and roentgenological procedure, and on the basis of misunderstanding of or disagreement on important anatomical physiological and physical problems. Up to the present there has been no uniformity in the standardization of the technique of the introduction of air into the spinal canal or in the various positions indicated for the roentgenological examination of the skull such as roentgenologists are accustomed to have in other forms of examination. This lack of standardized technique has led not only to the lack of proper knowledge of the procedure but also to misinterpretations.

For these reasons the President of the American Roentgen Ray Society has seen fit to appoint a committee of roentgenologists, neurological surgeons, neurologists, neuropathologists, physiologists and a professor of hydraulics to work over all of the problems involved and to attempt to standardize both the operative and the roentgenological technique. Groups for similar purposes have been selected in the past by other organizations, notably the Registry of Bone Sarcoma of the American College of Surgeons and the Normal Chest Committee of the National Tuberculosis Association. Both of these had to deal very largely with roentgenological work. The following members were selected for the Committee on the Standardization of Encephalography:

Dr. William Spiller, Philadelphia
Dr. Israel Strauss, New York City
Dr. Temple Fay, Philadelphia
Dr. Lewis Weed, Baltimore
Dr. H. S. Howe, New York City
Dr. Frank Freemont-Smith, Boston
Dr. N. W. Winkelman, Philadelphia
Prof. W. S. Pardoe, Philadelphia
Dr. Leopold Jaches, New York City
Dr. E. P. Pendergrass, Philadelphia
Dr. H. K. Pancoast, Philadelphia, Chairman.

The committee arranged the following program for discussion:

1. The normal encephalographic appearance following proper operative and roentgenological technique.
   a. The subarachnoid cortical air markings.
   b. The basal cisternae.
   c. The ventricular system.
   d. The absorption of air and the appearance after twenty-four, forty-eight, seventy-two hours and longer periods.
2. Roentgenological technique.
3. Brain atrophy.
   a. Cause of characteristic areas of the cortex usually involved.
   b. The probable causes for escape from atrophy of the under surface of the frontal lobe, the temporal lobe, and the occipital pole.
   c. Pathological studies differentiating cerebro-vascular cortical atrophy from generalized "pressure" atrophy.
   d. Distribution of the cortical atrophy in relation to the vascular fields.

   To open discussion:
   1. Dr. William G. Spiller (Philadelphia).
   2. Dr. Israel Strauss (New York).
   3. Dr. N. W. Winkelman (Philadelphia).
4. Cerebrospinal fluid circulation.
   a. The present evidence in favor of the production of cerebrospinal fluid.
   b. The approximate amount within our present knowledge of cerebrospinal fluid produced per day.
   c. The probable outlets or points of escape for cerebrospinal fluid.
   d. The effects of obstruction to the

cerebrospinal fluid circulation at points situated between its origin and elimination.

e. The probable relation of collections of cerebrospinal fluid to cortical pressure and atrophy.

f. Effects of obstruction to the circulation of cerebrospinal fluid in the light of the Monro-Kellie doctrine and the laws of hydrodynamics.

g. The relation of increase of pressure either local or generalized to the possible production of local or generalized cerebral atrophy.

To open discussion:

1. Dr. Lewis Weed (Baltimore).
2. Dr. Freemont-Smith (Boston).
3. Prof. William Pardoe (Philadelphia).

5. The types of changes noted in the subarachnoid spaces by encephalography.
   a. Enlargement or filling defects of the ventricles.
   b. Enlargement or filling defects of the cisternae.
      (1) magna.
      (2) pontis.
      (3) chiasmatis.
      (4) venae magnae cerebri.
   c. Enlargement of the sulci over the cortex. The characteristic involvement and distribution.
   d. Areas of localized fluid collection.
   e. Widespread areas of brain atrophy.
   f. Settling of the superior cortical surface into the space caused by enlargement of the ventricles.
   g. Interpretation of air shadows at the vertex at different periods.
      1. Dr. Israel Strauss (New York).
      2. Dr. Leopold Jaches (New York).
      3. Dr. Eugene P. Pendergrass (Philadelphia).
      4. Dr. Temple Fay (Philadelphia).
      5. Dr. Henry K. Pancoast (Philadelphia).
6. The probable causes for the mechanism of delay in escape of cerebrospinal fluid and the relation to cerebral atrophy, local and general.
   a. Post-traumatic.
   b. Birth injuries.
   c. Spontaneous and traumatic subarachnoid hemorrhage.
   d. Inflammatory processes.
   e. Toxic processes.
      1. Dr. Lewis Weed (Baltimore).
      2. Dr. Temple Fay (Philadelphia).
7. Correlation of the encephalographic and clinical findings.
   a. Acute manifestations of sudden increase in cerebrospinal fluid pressure.
   b. Chronic manifestations of increased cerebrospinal fluid pressure.
   c. Pathology of the Pacchionian bodies in acute and chronic conditions associated with increased cerebrospinal fluid volume.
   d. Widespread cortical lesions without focal evidence.
   e. Focal lesions with focal symptoms.

To open discussion:

1. Dr. William G. Spiller (Philadelphia).
2. Dr. Israel Strauss (New York).
3. Dr. Temple Fay (Philadelphia).
4. Dr. N. W. Winkelman (Philadelphia).

8. The probable relation between dysfunction of cerebrospinal fluid circulation and absorption to the occurrence of characteristic cortical and ventricular changes seen in encephalography.
   a. The significance of Pacchionian pathology.
      Dr. Winkelman (Philadelphia).
   b. The effect of pathological changes on cerebrospinal fluid absorption.
      Dr. Freemont-Smith (Boston).
   c. Specific reaction of the pia-arachnoid to blood within the subarachnoid space.
      Dr. Weed (Baltimore).
   d. The characteristics of brain atrophy without a vascular cause.
      Dr. Spiller (Philadelphia).
   e. The areas of brain involved in this atrophy.
      1. Dr. Jaches (New York).
      2. Dr. Pancoast (Philadelphia).
      3. Dr. Pendergrass (Philadelphia).
   f. The possible relation of this atrophy to a pressure mechanism due to increased amounts of subarachnoid fluid.
      1. Dr. Weed (Baltimore).
      2. Dr. Fay (Philadelphia).

9. The formulation of a possible explanation for the various types of atrophy disclosed in roentgenograms.

The chairman was authorized to call meetings at convenient dates and places and to prepare the prospectus of the subject covered and previously outlined. A preliminary report was requested for the annual meeting of the American Roentgen Ray Society in 1929.

The first meeting of the Committee was held in Philadelphia, June 9, 1929. The following members were present: Dr. William G. Spiller, Dr. Israel Strauss, Dr. Temple Fay, Dr. N. W. Winkelman, Dr. Leopold Jaches, Dr. E. P. Pendergrass, Prof. W. S. Pardoe, and Dr. H. K. Pancoast.

Dr. W. J. Gardner, Philadelphia, was invited to attend as a representative of the Neurosurgical Service of Dr. Charles H. Frazier.

DISCUSSION

It is not possible to present all the lengthy details of the discussion, and the recorders were instructed to take down only the conclusions reached by the Committee on each subject as its discussion was completed. The following conclusions are herewith presented.

1. *Normal encephalographic appearances* following the proper operative and roentgenological technique.

It was realized that we cannot expect encephalographic procedures to be carried out on normal individuals, and the best that we can do is to declare our judgment as to what is approximately normal from a large number of negative encephalographic studies.

a. *Subarachnoid cortical air markings* replacing the usual fluid pathways.

(1) *Distribution.* The Committee agreed that, in the normal, these pathways are confined to the frontal and parietal surfaces of the brain over the external cortical surface. The Sylvian fissure represents their posterior and inferior boundary, and they are seldom found normally posterior to the parieto-occipital sulcus and a line connecting this point with the Sylvian fissure.

Midline. There is a distribution of air, though usually to a much less extent, over the mesial surfaces of the hemispheres above the corpus callosum in the midline, extending from the frontal region to the posterior portion of the paracentral lobule. This can be distinguished from the cortical air by the fact that the lines arise just above the corpus callosum.

The uniform distribution of these markings throughout the frontal and parietal lobes gives a definite cortical pattern in which the brain completely fills its dural casement without signs of fluid spaces existing over the cortex sufficient to give a demonstrable space between the inner table of the skull and the cortex.

The air is within the subarachnoid spaces between the convolutions, following the sulci over the above area of distribution.

(2) *Size of Markings.* These air markings, comparable to hairpin size, vary from 1 to 3 mm. in width on the flat roentgenogram taken at a 44 inch target film distance. The larger width represents the increased size due to projection of pathways from the opposite side of the head. This size also depends upon the roentgenograms being made *within one hour after the introduction of air.* This time element is a very important item in standardization of technique.

b. *Basal Cisternae.* If there is sufficient fluid withdrawn and sufficient air injected, the basal cisternae (cisternae magna, pontis, interpeduncularis and chiasmatis) should be plainly visible in the normal. After *cisternal puncture,* there is usually poor filling of the cisternae pontis, interpeduncularis and chiasmatis, probably because one cannot manipulate the head satisfactorily for adequate distribution when the needle is introduced into the cisterna magna, and there results a water trap effect.

The cisterna magna communicates directly with the upper cervical canal. It is bounded above by the under surface of the vermis, laterally by the cerebellar hemispheres and anteriorly by the medulla. It is continuous with the cisterna pontis through spaces which surround the medulla and pons and is seen only in the lateral views, and should show well normally.

The cisterna pontis surrounds the ante-

rior and lateral surfaces of the pons, and extends anteriorly to the basilar process of the occipital bone. It is seen only in the lateral views, and should show well normally.

The cisterna interpeduncularis is continuous with the cisterna pontis and is situated anterior to the peduncles of and posterior to the infundibulum. It is triangular in shape in the lateral view, with the apex up and the base continuous with the cisterna pontis. One must be quite familiar with encephalographic relations to make it out.

The cisterna chiasmatis is seen in the normal as a collection of air situated above the pituitary fossa and extending slightly anterior to it. It is frequently bisected by structures such as the optic chiasm, internal carotid artery and the infundibulum, which then cast perceptible shadows. It is seen on the lateral view only. It varies in size and shape, and the Commitee at its first meeting did not attempt to standardize the normal size.

The cisterna venae magnae cerebri was accepted by the Committee as a normal entity which, they believe, may contain a small amount of air under normal conditions, though any large amounts of air are abnormal. The small collection is situated anatomically above the vermis and extends anteriorly to the quadrigeminal and pineal bodies. It lies just below and anterior to the under surface of the tentorium in the midline. This cistern is capable of considerable abnormal distention and air will then extend well laterally.

The cisterna intercommunicans connects the cisterna interpeduncularis with the cisterna venae magnae cerebri. The Committee accepts this cistern as an entity. So far they have not found a name for it and have accepted this name until further search can establish some other correct anatomical designation, if any has been given. The cisterna intercommunicans lies bilaterally along the course of the fourth nerve. The air space usually measures 1 to 3 mm. in width upon the roentgenogram. It is seen in the lateral view as two small crescentic lines with the concavity toward the vertex.

c. *The Ventricular System.* If the lateral ventricles fill properly, air should be seen also in the third ventricle, aqueduct and fourth ventricle.

The Lateral Ventricles. The exact size and shape of these ventricles cannot yet be established because, up to the present time, there has been no uniformity whatever in the roentgenological technique and further observations must be made based upon some standardization of the procedure. There must be also a standardization of operative technique.

The Committee agreed that failure of the ventricles to fill with air, should, in the light of our present knowledge, be regarded as the result of an error in operative technique, unless it is satisfactorily proved that a pathological condition prevents filling. It was further agreed that if the ventricles did not fill, one examination was not sufficient for an assumption that a pathological condition existed. Either another partial examination should be made in twenty-four hours to see if the ventricles were then filled or another complete operative and roentgenological procedure carried out subsequently at a safe period.

It was recognized that obstruction to the passage of air but not to cerebrospinal fluid could exist due to the presence of an arachnoid membrane covering the outlets of the foramina of Magendie and Luschka, such as has been described by Bakeman.

With the lateral ventricles properly filled, they should be symmetrical as to size and shape and as to position on each side of the midline. The communication with the third ventricle through the formina of Monro should be seen in stereoscopic lateral views.

Third Ventricle. The outlines of the third ventricle are best seen in stereoscopic lateral views, and also its communication with the fourth ventricle through the aqueduct of Sylvius. The third ventricle should also be seen in the sagittal views, particularly to determine the presence or absence of midline shift. This must depend largely upon proper roentgenological technique.

d. *The absorption of air* was left for later discussion as it was a subject about which

the majority of the committee was in doubt.

2. *Roentgenological Technique.* The roentgenological members of the Committee considered that they were not yet quite in a position to be dogmatic in regard to all of the details concerning the roentgenological technique. Until roentgenologists become more familiar with requirements, and the subject in general, all that the roentgenological members of the Committee can do is to advise that their own technique be tried out. They must insist at the outset, however, that encephalograms are not worthy of an attempt at interpretation unless made in the erect posture, and, as previously stated, within one hour after the introduction of air.

3. *Brain Atrophy.*

a. It was accepted by the Committee that the *generalized* shrinkage and atrophy occurring in the frontal and parietal areas is a pressure atrophy of ischemic type. This was based largely but not entirely upon the conclusive results of the investigations of Dr. Winkelman upon atrophic areas of brain tissue in cases of alcoholism, paresis and epilepsy, and compared with non-atrophic areas, and in which he found the atrophy due directly to decrease in blood supply from pressure and not vascular changes. Changes produced by pressure atrophy are confined for the most part to the ganglion cells of the cortex and secondarily to the white matter. It was accepted at this time that the major evidences were in favor of the elimination of the fluid through the subarachnoid villi and the Pacchionian bodies, though this subject was to come up later for detailed discussion. On this basis, the pressure mechanism consists of a delay in the escape of the cerebrospinal fluid from the channels over the fronto-parietal area, thereby permitting excessive accumulations in the subarachnoid space.

The factors underlying these disturbances are probably those which impair or destroy the function of the Pacchionian bodies or subarachnoid villi, such as free hemorrhage in the subarachnoid space, trauma including birth injury, inflammatory or toxic processes and infiltrative processes such as metastatic carcinoma.

The fluid accumulations would respond to the laws of hydraulics, so that within the rigid confines of the skull a pulsating distribution of pressure would act directly on the walls of the fluid channels. Changes of pressure are produced by overproduction of fluid compared to its escape, by coughing, straining, crying and other exertions. They temporarily or more or less permanently cut down the capillary vascular supply, and with a fixed fluid "cast," favor pressure atrophy through ischemia, or favor lack of normal development.

b. The escape of the under surface of the frontal lobes and the temporal and occipital lobes from this type of atrophy cannot be explained upon the basis of a disturbed vascular plan, but it does conform with the area of cortical cerebrospinal fluid circulation. For this reason the atrophy usually seen involves the frontal and parietal cortical areas, and especially the opercular region. Occasionally the cerebellum and the first and second temporal convolutions are involved. Pressure atrophy has been found to occur in the temporo-occipital area only in those cases in which cerebrospinal fluid pathways have been diverted due to an obstruction in the anterior circulating field.

c. It was accepted by the Committee that this type of pressure atrophy was easily distinguishable pathologically and roentgenologically from areas of softening due to vascular lesions.

d. Distribution of atrophy confined to one of the cerebral arterial branches, in the presence of a definite history of a vascular lesion, will be interpreted as such when collections of air are found corresponding to the vascular plan, whereas *generalized* increased amounts of subarachnoid cortical air represent pressure atrophy.

Increased amounts of air seen over the cortex in encephalograms may be ascribed to *two* processes: (1) Those produced by pressure atrophy; (2) those produced by a lesion within the substance of brain, causing an area of degeneration as secondary to thrombosis, followed by a fibrosis and gliosis, with contraction, drawing the cortex and ventricular surfaces more closely together. The appearance will be that of an enlarged ventricle with little

or no midline shift and an area of increased air over the cortex on the same side. A failure of air to appear over the cortex in this manner may be considered as being due to an inability of fluid to properly drain out because of some obstructive process or to an obliterative plastic arachnoiditis and consequently loss of subarachnoid cortical air markings.

4. *Cerebrospinal Fluid Circulation.*

a. *The present evidence in favor of the production of the cerebrospinal fluid.* It was accepted by the Committee that the point of elaboration of cerebrospinal fluid, in the light of our present knowledge, is in the choroid plexuses of all the ventricles equally according to their development, and also accretions from the perivascular spaces opening into the subarachnoid spaces over the cortex of the brain and over the spinal cord.

ADJOURNMENT

The first meeting of the Committee was obliged to adjourn at this point in the discussion. The next meeting will take place at the earliest possible date.

NINTH NATIONAL CONGRESS OF MEDICAL RADIOLOGY

The Ninth National Congress of Medical Radiology will be held in Turin in May, 1930, under the presidency of Professor M. Bertolotti. It is the intention of the President to have a discussion pertaining to two very important clinical subjects: The first subject refers to the "Roentgenological Diagnosis of Intracranial Tumors" and is assigned to Nuvoli of Rome who will take up the roentgenographic anatomy of the normal skull, and to Montanari of Ancona who will deal with the roentgenologic diagnosis of tumors of the base of the brain. The second subject is on "The Radiation Therapy of Hemopathies" and is assigned to Siciliano of Florence and to Bignami of Pavia. In addition to these, the illustrious clinician, Professor Feratta of Pavia, will give a lecture on the most important clinical questions pertaining to the subject.

The subjects chosen and the persons in charge give ample proof that the scientific part of the Congress will be of great interest and will permit a most prolific discussion.

Only papers dealing with the two above subjects will be presented at the Congress. In order that every communication may receive the necessary attention, the President has decided that the title and the summary shall be sent in not later than February, 1930.

The Congress will also have an important national and foreign roentgenological exhibit.

FIFTH INTERNATIONAL CONGRESS OF PHYSIOTHERAPY LIEGE, SEPTEMBER 4–8, 1930

The organization of this Congress is progressing rapidly and we would draw the attention of physicians to the real union which will take place in Liege on the occasion of the International Exposition and the Centenary of Independence.

The Congress of Physical Therapy presided over by Prof. Gunzburg and Prof. De Munter has already received recognition by twenty foreign committees, of which the French section will be under the presidency of Prof. E. Gley of the Academy; the Holland section under the presidency of Prof. Van Breeman, Secretary of the International League for Rheumatism; the Swiss section under the presidency of Prof. Rosselet of the University of Lausanne, Secretary of the International Committee on Light; the Spanish section under the presidency of Du Doyen Recasens of the Faculty of Medicine of Madrid; the section of the Grand Duchy of Luxembourg under the presidency of Dr. Schmollet Weyler; the section of Poland under the presidency of Dr. E. Faber; the Portuguese section under that of Dr. Pires de Lima de Porto; the section of the United States of America under the presidency of Dr. William Benham Snow, Editor of Physical Therapeutics in New York; the Brazilian section under the presidency of Dr. F. Barrozo; that of England under the presidency of Dr. Kerr Russell; the Austrian section under Prof. Strasser of Vienna; Germany under Prof. Grober of Jena; Hungary

under Professor von Dalmady; the French Colonies in Africa under Dr. Augebaud d'Oran.

The important questions proposed are: (*a*) Rheumatism and Physiotherapy Treatment. Papers by Profs. Gunzburg for Belgium, Van Breeman for Holland, Wierzejewsky for Poland; (*b*) Affections of the Central Nervous System and Physiotherapy. Paper by Dr. Delherm for France.

Sections on Kinesitherapy, Electrology, Hydrology, Radiology and Actinotherapy will treat of special questions, for which about thirty authors were solicited on the 15th of September, 1929.

These sections will be organized according to the number who attend the Congress at Liege: International Committee on Rheumatism, International Committee on Light, Curie Institute in Paris, Institute of Actinology in Paris, American Physical Therapy Association, American Roentgen Ray Society, Radiological Society of North America, Physiotherapeutic Sections of Paris, Belgium, Antwerp, Societies of Radiology of France, Poland, Belgium, French Society of Electrotherapy, French Federation of Medical States for Physical Education and Sports, Society of Hydrology of Belgium.

Acceptances may be sent from now on to Dr. Dubois-Trepagne, Secretary-General, 25 Louvrex Street, Liege, Belgium, with the dues of 150 Belgian francs. This will facilitate the organization of a Congress which will be noteworthy among the sessions of 1930.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DIE HERZERWEITERUNG IM DURCHLEUCHTUNGSBILD. By Emile Bordet, Paris. With a foreword by Henri Vaquez. German translation by A. Eugster, Zurich. Price, 8 Marks. Pp. 138, with 73 illustrations. 1928: Georg Thieme, Leipzig.

Twenty years ago, Groedel of Nauheim, following the principles of Moritz, established the technique of the orthodiagraphic measurements of the heart, and since then others, especially Haudek, have perfected the method. The accuracy in development and its applicability, however, are due to Vaquez, and his pupil Bordet now furnishes us with the present status of the clinical application of the method.

Of general interest is Bordet's discussion of possible errors. These are dealt with in three separate groups: First, errors of technique. Roentgenograms or orthodiagrams which serve as a basis of examination may not correspond to the actual conditions in the individual case; second, errors of interpretation. These will occur unless the roentgenologist is thoroughly familiar with the principal pathologic-anatomical possibilities which knowledge is of prime importance in the interpretation of the image; third, errors due to the fact that not all clinical symptoms are known to the roentgenologist at the time of the examination, regardless as to whether the roentgenologist did not take a complete history or whether data were not communicated to him. The sources of the first two errors, the technical and pathological, are generally known. As to the importance of the third, that is, the ignorance of the clinical symptoms, the opinions are divided. In connection with this, two examples are cited from the book. For example, the roentgenologist unless he observes or detects functional disturbances or valvular murmurs is apt to omit the examination of the patient in all positions, especially when the morphologic changes found at the examination are not sufficiently pronounced to warrant the use of all methods at our disposal. Thus, if the image of the ventricles does not show a typical lateral configuration of the heart, the examination of the atria and auricles in the oblique positions is omitted or only summarily carried out. From this the observer concludes that there is a normal heart. If, however, his attention is called to the fact that the rhythm and the symptoms point to mitral stenosis he will not fail to examine the anatomical condition of the left auricle, the dilatation of which may be so slight that it can be detected only in certain favorable roentgenoscopic positions of the posterior mediastinum.

As a second example, a young individual presents at the roentgenoscopic examination an enlarged dilated heart, a condition which is commonly observed in valvular lesions. Now if in addition to the usual clinical symptoms, other symptoms pointing to the probability of a concretio cordis cum pericardio are present but the roentgenologist not notified thereof he may fail to search for such a condition because nothing will indicate to him that a lesion of the type mentioned may exist. Special methods are necessary in order to detect its presence and it is certain that a thorough roentgenoscopic examination would lead to the detection of these pathological conditions, also that preliminary knowledge of the clinical symptomatology would be of great aid. But a long roentgenoscopic examination is not best for the patient nor for the examining physician; furthermore, since long examinations are very tiresome a thorough report of the clinical findings should be required.

It seems wise to the reviewer to bring these ideas which lead into the domain of general medicine to a close. Generally speaking, one may say that the roentgenologist should know the essential findings of all simple clinical methods at the time of the examination. As regards the methods which are more complicated and more difficult than the roentgen examination as, for example, electrocardiography, the following general principles are worthy of consideration. The methods should be applied in the order of their complexity, each subsequent method being based on the essential findings of the preceding one. If for any reason the rational continuity in the chain of the complicated methods is broken, only the main procedures should be applied and the supplementary procedures reserved for later use. It must be mentioned here that many attending physicians have long followed this rule, while others pay no attention to it. Two more important statements of the authors who are both clinicians: "As long as the physician stands in front of a roentgenoscopic screen he must

act exclusively as a roentgenologist" and "The physician is a polytechnician."

The greatest value of the little book is its special part. G. Holzknecht.

Neuere Erfahrungen auf dem Gebiet der medizinischen Elektrizitätslehre mit Ausschluss der Röntgenlehre (Elektrophysik, Elektrophysiologie, Elektropathologie, Elektrodiagnostik, Elektrotherapie). Edited by Prof. Dr. med. Ludwig Mann, Breslau, and Prof. Dr. med. Franz Kramer, Berlin. Paper. Pp. 501, with 258 illustrations. Leipzig: Georg Thieme, 1928.

This book is a supplement to the lexicon on the use of electricity in medicine which appeared in 1909–1911. It is the work of fifteen authors, thus giving a most comprehensive presentation of the subject. The introductory chapter by G. Hoffmann is on the electron, atom, radioactivity, and ionization, which is followed by a short discussion of the electrical apparatus used in medicine (K. Bangert). The next contribution, and one of the best in the whole book, takes up the present status of electrophysiology (W. Steinhausen). The wide use of the electron tube in physiology is most interesting, and the author has done pioneer work along these lines. The articles by H. S. Schaffer on technique and methods used in electrocardiography and the interpretation of the electrocardiogram in pathological conditions will be welcomed by many readers. Of great importance is the chapter by E. Schilf on injuries of the organism due to electrical currents, a special subdivision sometimes called electropathology. The next essay (F. Kramer) dealing with general electrodiagnosis, its application in nerve and muscle diseases, offers much valuable information.

The section on therapy is opened by a chapter on general electrotherapeutics (L. Mann), followed by a discussion of the franklinization and the treatment with high frequency currents (J. Kowarschik), and electrolysis (C. A. Hoffman). The remainder of the book is taken up with the specialties. There are articles on electrotherapy in nerve and muscle diseases (L. Mann), in internal diseases, particularly those of the heart (F. M. Groedel), the use of electricity in rhinolaryngology (A. Alexander), in otology (W. Klestadt), in ophthalmology (O. Fehr), in skin diseases (C. A. Hoffmann), and in diseases of the joints (L. Mann). The editors state in the preface that gynecology had to be omitted because the author to which that chapter was assigned found it impossible to finish the material without delaying the publication of the book. E. A. Pohle.

Gli elementi fisici e biologici della radioterapia. By Prof. Mario Ponzio, Direttore dell'Instituto Radiologico Mauriziano di Torino. Cloth. Pp. 519, with 91 illustrations. Torino: Unione Tipografico-Editrice Torinese, 1927.

In this book the author presents what may be called the *science* of radiotherapy in contradistinction to the art which the term usually implies. Thus the reader will find no reference here to therapeutic technique or clinical problems. On the other hand, the author gives a very satisfactory résumé of the scientific principles which form the basis of practical radiotherapy.

The book is divided into two equal parts, Radiophysics and Radiobiology. In the latter are included chapters on selectivity, sensitivity, means for influencing tissue sensitivity, action of radiation on different organisms, organs, glands, etc.

Numerous authors are quoted in the text, but no references are given. The addition of a bibliography correlated with the quotations would make the book more valuable.

G. Failla.

BOOKS RECEIVED

Die Röntgendiagnostik der intrathorakalen Tumoren und ihre Differentialdiagnose. Von Dr. Robert Lenk, Dozent für medizinische Röntgenologie an der Universität Wien. (Band 1. Handbuch der theoretischen und klinischen [allgemeinen und speziellen] Röntgenkunde. Herausgegeben von Guido Holzknecht.) Paper. Pp. 457, with 217 illustrations. Wien: Julius Springer, 1929.

Röntgenatlas der Lungentuberkulose des Erwachsenen. Von Dr. med. Hanns Alexander, Leitender Arzt, and Dr. med. Arthur Beekmann, Oberarzt, des Sanatoriums Agra. Second enlarged and improved edition. Paper, price 36.00 Rm.; bound, 40.00 Rm. Pp. 493, with 321 roentgenograms and 4 illustrations in the text. Leipzig: J. A. Barth, 1929.

Die Photographischen Grundlagen des Röntgenbildes. Von Dr. Richard Herz, Frankfurt a. M. Paper, price 17.00 M.; bound, 19.00 M. Pp. 225, with 154 illustrations. Leipzig: Georg Thieme, 1929.

Radium Treatment of Cancer. By Stanford Cade, F.R.C.S. (Eng.), Assistant Surgeon, Joint Lecturer on Surgery and Teacher of Practical Surgery, Westminster Hospital; Late Hunterian Professor and Arris and Gale Lecturer, Royal College of Surgeons of England. Cloth. Price, $5.50. Pp. 154, with 13 colored plates and 49 text figures. New York: William Wood & Co., 1929.

Die Radiumbelhandlung in der Augenheilkunde. Von Dr. Leo Kumer, o.ö. Univ.-Prof., Insbruck, Gew. ass. d. Univ.-Klinik f. Dermat. u. Syphil., in Wien (Vorstand Prof. Dr. L. Arzt), and Dr. L. Sallmann, Assistent der II. Universitäts-Augenklinik in Wien (Vorstand Prof. Dr. K. Lindner). Paper. Price, 14.40 Rm. Pp. 198, with 65 illustrations. Wien: Julius Springer, 1929.

Die Radiumtherapie: Methoden und Aussichten. Von Dr. med. F. Gudzent, a. o. Professor an der Universität Berlin. (Band v. Medizinische Praxis. Herausgegeben von Prof. Dr. L. R. Grote, Prof. Dr. A. Fromme and Prof. Dr. K. Warnekros.) Paper, price 6.50 Rm.; bound, 8.00 Rm. Pp. 106, with 53 illustrations. Dresden and Leipzig: Theodor Steinkopff, 1929.

Abrasio und Probeexzision in der Hand des praktischen Arztes. Von Prof. Dr. Wilhelm Lahm, Obermedizinalrat. Vorstand des Laboratoriums der staatlichen Frauenklinik in Chemnitz. (Band vi. Medizinische Praxis. Herausgegeben von Prof. Dr. L. R. Grote, Prof. Dr. A. Fromme, and Prof. Dr. K. Warnekros.) Paper, price 11.00 Rm.; bound, 12.50 Rm. Pp. 180, with 2 illustrations. Dresden and Leipzig; Theodor Steinkopff, 1929.

La coxite gonococcique. By Marthe Lamy. Paper. Pp. 250, with 31 illustrations. Paris: Gauthier-Villars et Cie, 1929.

Osteomyelitis and Compound Fractures and Other Infected Wounds: Treatment by the Method of Drainage and Rest. By H. Winnett Orr, M.D., F.A.C.S., Chief Surgeon of the Nebraska Orthopedic Hospital, Orthopedic Surgeon Lincoln General Hospital, Consulting Orthopedic Surgeon Bryan Memorial Hospital, Lincoln, Nebraska. Cloth. Price, $5.00. Pp. 208, with 54 illustrations. St. Louis: The C. V. Mosby Co., 1929.

Das Röntgeninstitut der chirurgischen Universitätsklinik im städtischen Kraukenhaus Sachsenhausen in Frankfurt a. M. Von Hans Holfelder, o.ö. Professor für allgemeine klinische Röntgenkunde, and Walter Körte, Städt. Baurat, Frankfurt a. M. Paper. Price, 3.50 M. Pp. 36, with 52 illustrations. Leipzig: Georg Thieme, 1929.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Balestra, Giovanni. Tuberculous osteoarthritis of the anterior tarsus probably complicating Köhler's disease of the scaphoid. *Radiol. med., Aug.*, 1929, xvi, 776–784.

A case is described in a child six years of age who had no family history of any importance. He was in a good condition of development and nutrition. After a trauma clinical signs of a tuberculous osteoarthritis of the anterior tarsus on the right side developed. On this side in addition to a thickened and irregular scaphoid, the roentgen picture showed erosion of the upper edges of the two first cuneiform bones, quite marked decalcification of these bones, reduction of their joint lines and diffuse osteoporosis of other parts of the bones of the foot. A comparative examination showed that the scaphoid bone on the left side resembled the scaphoid of Köhler's disease though there were no clinical symptoms of this disease. The author thinks that this was a case of tuberculosis of the anterior part of the tarsus complicating a Köhler's disease of the scaphoid, that some of the cases of tuberculous scaphoiditis reported in the literature in which the roentgen picture simulated Köhler's disease may be interpreted in the same way and that there is no reason to believe that Köhler's disease is tuberculous in origin.

Benassi, E. Stimulation of the gall-bladder by cholin and acetylcholin studied by means of cholecystography. *Arch. di radiol.*, Mar.-Apr., 1929, v, 396–399.

The author has previously made roentgen studies of the function of the gall-bladder under various pharmacodynamic tests. In this article he describes tests with cholin and acetylcholin and finds that they, like the other parasympathicotropic drugs, have a distinctly stimulant action on the movements of the gall-bladder. Under the action of these two drugs the gall-bladder contracts and expels its contents into the duodenum, which has been rendered opaque with sodium tetraiodophenolphthalein. These experiments support the theory that the vagus is the motor nerve of the gall-bladder.

Blank, George M., and Graves, Gaylord W. The unusual association of postinfantile rickets with osteomalacia. *Am. J. Dis. Child.*, July, 1929, xxxviii, 84–94.

The authors carefully review the literature covering the age incidence of rickets and of osteomalacia. The latter closely simulates rickets and is considered by many to be practically identical with rickets, and occurs typically in persons whose endochondral ossification is complete, particularly in women, with exacerbations during pregnancy and the nursing period. Five cases are reported from the 1928 Summer service of the Seaside Hospital of St. John's Guild, New York, to illustrate the fallaciousness of the popular belief that active rickets is a disease limited to the first two or three years of life. The reports further emphasize the extreme importance of careful roentgen studies in rachitic cases before the institution of operative orthopedic measures, in order that the surgeon may be sure that the structures on which he works will not be subject to recurrence of static insufficiency and deformity. Correlation of the authors' observations with the rather meager reports available concerning osteomalacia warrants the belief that it is of more frequent occurrence and of more grave significance than has been generally believed, since, notwithstanding the fact that this disease is usually recognized only after slight changes have occurred; slight forms recognizable as soon as static insufficiency is noticed are incomparably more frequent, the osteomalacia insufficiencies being rather more numerous. They believe that the possible existence in advanced cases presenting "rachitic deformity," of actual osteomalacia masked by primary associated rickets, opens up a field of great importance, especially to the orthopedist.

The roentgenograms of the reported cases showed typical rachitic changes in the long bones but in addition there was apparent a superimposed condition of osteoporosis, the changes in the epiphysis and the shaft together affording an appearance more complex than that found in the typical picture of osteomalacia lesions in adult bones.

Blank and Graves conclude that active rickets is by no means uncommon in early childhood after the age of three years and before adolescence.

Although osteomalacia has not been considered a disease of childhood, the existence of defects of the bone characteristic of this condition has been shown in 3 of the patients of their series ranging from three and one-half years to six years.

Although rickets and osteomalacia have

not been proved essentially identical, their observations suggest that there may be no no definite dividing line between the two conditions.

In 3 of their cases, the coexistence of postinfantile rickets and osteomalacia seems beyond question, notwithstanding the admitted infrequency of such association.

Recognition of postinfantile rickets and osteomalacia, whether occurring singly or combined or as separate phases of an identical disease process, is of the utmost importance to the orthopedic surgeon, since no operation should be performed on patients in the active stage of rickets or osteomalacia.—*R. S. Bromer.*

Bloomfield, Arthur L., and Polland, W. Scott. The diagnostic value of studies of gastric secretion. *J. Am. M. Ass.*, May 4, 1929, xcii, 1508–1513.

With the advances in roentgenologic technique of the past few years, tests of gastric function have been more and more neglected in the studies of disorders of the stomach. The test meal has to some extent fallen into disrepute, but it is the authors' purpose in this paper to show that carefully standardized studies of gastric function play an essential part in diagnosis, and may even lead to a correct understanding of the condition after other methods have failed.

In testing any physiologic function, certain criteria must be observed if data of comparative value are to be obtained. First, the test must be applied under standard conditions. Secondly, the stimulus of work which makes up the test must impose a load on the function to be tested. Thirdly, they must be susceptible of identical repetition, for if the stimulus is not accurately standardized, a repeated test may show variable results. Finally, from a clinical standpoint, a useful functional test must yield data sufficiently complete to enable the observer in practice to draw conclusions of real diagnostic value.

The author finds the test meal unsatisfactory in the study of disorders of the stomach as it is not accurate. The introduction of 7 per cent alcohol into the stomach was too cumbersome for routine work.

The author gives a detailed description of his method of procedure in obtaining the two essential items of information desired, namely, the acidity of the pure juice and the volume of gastric secretion.

After arriving at normal standards, the author gives the history of 5 cases whereby he shows that the measurement of the volume of secretion and the determination of acidity are big factors in arriving at a correct diagnosis.—*E. P. Pendergrass.*

Brailsford, James F. Deformities of the lumbosacral region of the spine. *Brit. J. Surg.*, April, 1929, xvi, 562–627.

The material for this very complete paper is based upon roentgenograms of over 3000 patients attending several different types of hospitals during the past two years. A clinical examination was made of those patients whose roentgenograms showed any deformity of the lumbosacral area. In addition the lumbosacral area of 40 post-mortem subjects was investigated by dissection and the specimens in the museums of the Royal College of Surgeons and the University of Birmingham were examined and photographed.

The anatomy of the lumbosacral regions is thoroughly described. In his description of his roentgenographic technique the author insists that roentgenograms must be of good quality, should include both the anteroposterior and lateral planes, and occasionally anteroposterior stereoscopic views, with either a transverse or longitudinal shift of the tube. Views made with the central ray parallel with the inferior surface of the fifth lumbar vertebra, the tube pointing obliquely in the proximal direction with an angle of 40° from the vertical are also useful. This prevents an apparent crowding together of the fifth lumbar and first sacral vertebrae on the roentgenogram owing to a sharp lumbosacral angle. The roentgenograms should be made with a tube giving the softest rays consistent with the necessary penetration, so as to obtain the maximum of contrast. In children and thin patients a soft gas tube with intensifying screens and duplitized films, without the Potter-Bucky diaphragm is recommended.

The deformities due to developmental abnormalities are spina bifida occulta of the fifth lumbar vertebra, also of the first and second sacral, sacralization of the fifth lumbar vertebra, either one or both sides, and hemivertebra as found in the author's series of cases. In his discussion of spondylolisthesis, the author concludes that this condition is not as frequently found as has been maintained by certain authors. In fact, a few of the cases so reported have been diagnosed by anteroposterior roentgenograms alone and in some instances the characteristic appearance of the fifth lumbar vertebra in this condition was not really shown. With a definite case of spondylolisthesis the superior surface of the fifth lumbar vertebra is facing forward, and an anteroposterior roentgenogram will show the

fifth lumbar body and the transverse processes in this plane, and this characteristic outline of the anterior border of the body and the transverse processes will be projected against the shadow of the sacrum. The lateral view however furnishes almost absolute proof of the presence of anterior "slipping" of the fifth lumbar body on the sacrum. But even this view is not absolutely pathognomonic and may be misleading. A combination of both planes is necessary.

Deformities due to injury are discussed including fractures of the transverse processes, fracture dislocations of the bodies and compression fractures. Deformities due to pathological changes in the bones and joints are caused by acute infections from such organisms as staphylococci, streptococci, pneumococci, gonococci and typhoid bacilli, from organisms causing chronic infections such as the tubercle bacillus, the spirochete of syphilis and actinomycosis, by simple and malignant neoplasms, and by deficiency diseases and other bone diseases such as rickets, Paget's disease, and osteomalacia. Each of these is described in detail.

The appearance of a knuckle kyphos may be due to: congenital abnormalities of the neural arch; spondylolisthesis; inflammatory lesions other than tubercle; neoplasms, and aneurysm. Congenital abnormalities are often unaccompanied by pain, and anteroposterior and lateral views will show the nature of the abnormality. Spondylolisthesis generally shows a characteristic deformity of the lumbosacral area, often unaccompanied by pain. Tubercle infection with destruction sufficient to produce the deformity would be accompanied by pain, muscle rigidity of the part, and probably by abscess formation. Inflammatory lesions other than tubercle are usually accompanied by more new bone formation, and lipping of the adjoining vertebral bodies may be shown. Of the neoplasms, sarcoma usually shows a greater tumor formation which has developed rapidly, but the roentgenographic appearance varies with the type of sarcoma. In carcinoma there is often a history of a primary focus in the breast, prostate, kidney, thyroid, etc. Osteomas may be multiple. Aneurysm of the abdominal aorta may cause characteristic erosion of the vertebral bodies. Changes in the spine due to syphilis may be seen associated with gummata, neuropathic arthropathy in tabes, and aneurysm due to syphilitic aortitis.

This paper is extremely interesting from the roentgenographic point of view, contains much valuable information and should be read in its entirety. It is profusely illustrated and contains a very extensive review of the literature with a complete bibliography.

The author's conclusions are as follows:

1. Developmental irregularities of the lumbosacral region of the spine may be present without giving rise to symptoms. A careful investigation into all possible causes of symptoms of which the patient complains should be made before attributing the symptoms to such an irregularity.

2. The most frequent deformity associated with a developmental irregularity is the scoliosis due to asymmetrical sacralization of the fifth lumbar transverse process.

3. The deformities due to developmental irregularities which alter the alignment of the vertebrae tend to become more pronounced with age.

4. The characteristic indication of spondylolisthesis on an anteroposterior roentgenogram is the continuity of the outline of the transverse processes and the anterior border of the body of the fifth lumbar vertebra. The absence of this in the roentgenograms of some of the published cases suggests an error in diagnosis.

5. Spondylolisthesis is a relatively rare deformity.

6. The prominent "knuckle" deformity when present is often due to the projection of the fifth lumbar spine and not the upper border of the sacrum.

7. The study of the specimens and roentgenograms of cases of spondylolisthesis negatives the suggested possibility of manipulative reduction of the displacement.

8. Spondylolisthesis occurs in children of both sexes, sometimes without symptoms, and if due to trauma, the injury must have been in early life.

9. Severe trauma to the lumbosacral region in the adult can occur without producing spondylolisthesis.

10. The consolidation which follows the treatment of tuberculous caries of the lumbosacral region of the spine obliterates the lumbosacral angle and reduces the possibility of spondylolisthesis.

11. Roentgenograms may not show any evidence of injury to the lumbosacral region until organization and calcification of the damaged structures have taken place, after which the roentgenograms taken at intervals show an increase in the deformity.

12. Symptoms and deformity following injury to the lumbosacral region in which osteoarthritic changes have occurred may be more pronounced than would be expected from the degree of trauma.

13. Carcinoma and Paget's disease of the lumbosacral spine produce definite changes in the bone which can be recognized on a roentgenogram before any clinical deformity is apparent, and the pain associated with these conditions may be referred by the patient to a recent injury.—*R. S. Bromer.*

Casazza, Roberto. Unusual bone lesions in acquired syphilis. *Arch. di radiol.*, Jan.-Feb., 1929, v, 45–82.

After a discussion of bone syphilis in general, the author gives detailed descriptions, illustrated by roentgenograms, of a case of syphilitic panosteitis of the humerus in a man aged fifty-two, that simulated sarcoma and was cured by syphilitic treatment, and one of acute syphilitic osteomyelitis of the humerus in a man of twenty-seven, with woody myositis of the soft parts. A detailed discussion of differential diagnosis and treatment is given in both cases. In cases like the first it is difficult to make a differential diagnosis from sarcoma, and ones like the second may be confused with pyogenic osteomyelitis if a very careful study is not made. While the roentgen findings were very important in both these cases they did not definitely prove the nature of the bone disease. It is true that in some cases diagnosis can be made almost with certainty from the roentgen examination alone but even in such cases a complete clinical examination should also be made, and in most cases the roentgen examination is only one element in the diagnosis. As an illustration of this the author cites a case of Kleeberg; the roentgen picture was typically that of syphilitic periostitis and a diagnosis was made of this disease in an old syphilitic though the Wassermann and Meinicke reactions were negative. Sarcoma developed rapidly and ended in death in spite of energetic roentgen treatment.

Cignolini, P. The relation between the hypophysis and the roentgen picture of the sella turcica. *Arch. di. radiol.*, Jan.-Feb., 1929, v, 1–24.

The technique of taking a roentgenogram of the sella turcica is described in detail and the normal measurements of the sella given. The best projection is a lateral one with the biauricular axis vertical to the plane of the plate. In many cases both a right-left and a left-right picture should be taken so as to compare the two sides. From a careful study of such lateral roentgenograms the author concludes that there is marked parallelism between the volume of the hypophysis and the size of the sella. He criticizes the findings of authors who have reached the opposite conclusion and thinks that they are due to errors in judgment caused by faulty technique. He emphasizes the fact that the capacity of the sella is not determined by the position of the clinoid processes. A study of these processes is extremely interesting from the point of view of morphology, and changes in their direction, density and position may give indications in regard to the condition of the gland and of intracranial pressure, but they do not determine the capacity of the sella.

But having established the parallelism between the size of the sella and the volume of the hypophysis, the question is whether the function of the hypophysis is in proportion to its size. There are many exceptions to this parallelism because of endocrine-nervous influences and quantitative and functional disequilibrium between the active cells of the gland itself; and the discrepancy between the roentgen findings and the symptomatology of the patient is due to this fact and not to defects in the roentgen findings.

Coryllos, Pol N. Postoperative apneumatosis (atelectasis) and postoperative pneumonia. *J. Am. M. Ass.*, July 13, 1929, xciii, 98–99.

The experimental work in the Laboratory of Surgical Research at Cornell Medical College led the author to the following conclusions:

1. Bronchial obstruction is the one determining cause of atelectasis.

2. This occlusion must be complete.

3. No other cause such as bronchomotor or vasomotor, embolism can be or has been proved to be the determining cause of apneumatosis.

4. Postoperative immobilization of the thoracic cavity by pain, impairment of cough and respiratory movements by narcotics and posture are only favoring factors. The dominent fact is bronchial obstruction and free bronchial drainage.

5. The fate of the lung after bronchial obstruction depends on the microbes infecting the obstructing mucus. A non-virulent Type IV pneumococcus will produce atelectasis, a more virulent pneumonia; pyogenic or anaerobic organisms will produce lung suppuration or gangrene.

6. In atelectasis pneumococcus Type IV is always present just as in pneumonia. There is only a difference in degree of virulence.

7. Clinical evolution, roentgenographic study, pathological changes, and above all experimental investigation offer evidence for the conception.—*E. P. Pendergrass.*

Feci, L. Chronic bone abscess. *Arch. di radiol.*, Jan.-Feb., 1929, v, 83–111.

This study is based on the characteristic roentgen picture of Brodie's abscess only; 11 cases of the disease are described that have been seen in the last five years at the Surgical Clinic of the University of Parma. The author concludes that solitary bone abscess does not always present the roentgen picture that is generally described as characteristic of it and that it is impossible to make a definite roentgen diagnosis of the nature of a circumscribed focus of chronic osteomyelitis.

Gardner, W. J., and Frazier, Charles H. Ventriculography without air injection. *J. Am. M. Ass.*, July 20, 1929, xciii, 193–194.

Ventriculography is a valuable means of localizing a brain tumor otherwise unlocalizable. The operation is attended by a certain amount of risk and the authors have attempted to lessen this as much as possible.

In the early days of ventriculography the ventricular fluid was withdrawn 10 c.c. at a time, and this was followed by 10 c.c. injections of air. Marked fluctuation was caused in the intraventricular pressure. The frequent connecting and disconnecting of the syringe caused some movement of the cannulas, and this was another factor of cerebral trauma.

The technique now used differs from the old technique in that 1 c.c. of indigo carmine is injected into one ventricle. The fluid is collected from both ventricles, and if the indigo carmine appears in both then there is a connection between them. The head is then lowered and rotated to one side, and as the fluid flows from one cannula air is aspirated into the other. When the fluid ceases to flow, intermittent jugular compression is used. Thus practically all of the fluid is withdrawn from the ventricular system. At the conclusion the patient's condition is usually satisfactory.

Those who are particularly interested in this work should read the technique in detail and see the illustrations.—*E. P. Pendergrass.*

Gargiulo, M. Systematic roentgen study of fracture of the pelvis. *Arch. di radiol.*, Mar.-Apr., 1929, v, 321–341.

Cases of the various forms of fracture of the pelvis are described and illustrated with roentgenograms. The author gives an extensive discussion of the mechanism of production of these lesions. Whatever the directon of application of force to the pelvis the pubis is generally the first bone to yield. In total fracture of the pelvis diagnosis is comparatively easy even without roentgen examination but in the cases classified as contusion of the pelvis and concussion of the viscera roentgen examination is absolutely essential to an accurate diagnosis.

Glaser, Mark A., and Kutzmann, Adolph A. Emulsified campiodol as a pyelographic medium. *Ann. Surg.*, Aug., 1929, xc, 270–280.

This paper records the authors' preliminary experiences with an emulsion of a new iodized oil, campiodol (Frazier and Glaser), applied for the first time as a pyelographic medium. In the experimental work to find the most efficient medium for injection for the purpose of mapping by the roentgen ray the various tracts and cavities of the body, thirteen elements were studied, and of these iodine was found to be the most suitable. As contrasted with bromine, iodine belongs to that small group of elements possessing the property of selective absorption of the roentgen ray. Iodine and its compounds present an opacity far greater than might be expected from its atomic weight. The relative density of the roentgen-ray shadow of an iodine solution increases with the penetration of the rays while that of bromine, for instance, decreases.

In an effort to determine the best iodine compound for roentgenographic visualization, the various iodides, periodates, iodized fluorescin and other inorganic and organic compounds were used for experimental purposes. Many of these products proved unsatisfactory because of their insolubility and others failed to cast sufficient shadows. All of these, upon cisternal injection proved to be toxic and for this reason attention was diverted to other substances. Certain oils were tried for combination with iodine and of these rape-seed oil, also known as colza oil was finally determined to be the most satisfactory. The combination of iodine with rape-seed oil, campiodol, deteriorates very slowly upon exposure to light and heat, and upon roentgenographic exposure an intense shadow is obtained, so much so that dilution products may readily be made without destroying its clinical value. It has a very low toxicity, and extremely slight irritating qualities.

A straight iodized oil is unsatisfactory for pyelography because of its high viscosity and non-miscibility. Thus emulsions are necessary. Several emulsifying agents were tried and acacia proved to be the best. The final product contained one-half of acacia solution and the other half iodized oil, this forming a stable solution. It was prepared in sterile ampules and sealed, and further sterilized by exposure to pressure at a temperature of 100° C. Upon bacteriological examination this product proved sterile. The authors' summary follows:

1. Emulsified campiodol, used as a pyelographic medium is inert, non-irritating and non-toxic; it is miscible with water and does not precipitate with the salts of the urine and possesses excellent shadowgraphic properties, both as to intensity and to detail.

2. Emulsified campiodol has been used in 25 cases with a minimum of irritative symptoms, and therefore possesses a distinct advantage over 12.5 per cent sodium iodide.

3. Emulsified campiodol gives excellent ureterograms.

4. Emulsified campiodol mixes with the urine in the kidney pelvis; its viscosity is much less than that of other iodized oils and hence is superior to them.

5. Emulsified campiodol is a stable emulsion of iodized rape-seed oil, composed of iodized rape-seed oil, acacia solution and distilled water.

6. Campiodol is an iodized rape-seed oil containing approximately 4.3 per cent elemental iodine.—*R. S. Bromer.*

Henderson, Yandell. The physiology of atelectasis. *J. Am. M. Ass.*, July 13, 1929, xciii, 96–98.

The closure of a bronchus or bronchioles is a determining factor in the development of pneumonia. The lungs are normally the best drained organs in the body, as the respiratory tract is able to free itself of obstructions and secretions by coughing, the action of cilia, and the peristaltic movements in the air sacs, bronchioles and bronchi. Shallow breathing strongly predisposes to bronchial obstruction and thus to atelectasis.

The deep breathing induced by carbon dioxide has already proved capable of keeping the lungs open. "Inhalation of carbon dioxide thus offers a prophylaxis of probable value in the early stages of pneumonic infection," is the author's conclusion. In Pittsburgh 126 patients had pneumonia and were treated with carbon dioxide. Of these cases only 9 died. Carbon dioxide was of value even in advanced stages.—*E. P. Pendergrass.*

Luccioni, C. Anterior sacrococcygeal teratoma simulating vesical calculus. *Arch. di radiol.*, Mar.-Apr., 1929, v, 393–395.

A girl two years of age was brought to the hospital because about three months before she had begun to have stubborn constipation, dysuria and increasing pollakiuria. A surgeon made a diagnosis of stone in the bladder which seemed to be confirmed by roentgen examination. Surgical operation was advised but the parents hesitated because of the child's age; but the symptoms increased and the child lost strength so rapidly that they finally decided on operation. The author examined the roentgenogram and found several shadows close together, some of them very dense, which did look like polyhedral calculi facetted from mutual pressure. But they seemed to be lower down than they should have been for bladder calculi on a roentgenogram taken with the normal projection and with the patient lying down. For greater certainty a cystoscopic examination was made under ether anesthesia and the bladder found free of calculi. Rectal examination showed a hard nodular mass completely filling the concavity of the sacrum and coccyx; it reached up to the promontory, infiltrated the rectum and in fact filled almost the whole pelvis. A new roentgenogram was then made and compared with the one made two months before. The three shadows on the right were found to be three free teeth, that on the left two teeth implanted on a fragment of maxillary bone. This was a sacrococcygeal teratoma. The infiltrating growth and rapidly increasing cachexia showed that it had undergone malignant degeneration so operation was not advised. The urinary symptoms were due to the pressure of the tumor on the bladder.

Maffei, G. B. A case of Pellegrini-Stieda's disease (paracondyloid ossification of the knee). *Radiol. med.*, July, 1929, xvi, 686–692.

A case of Pellegrini-Stieda's disease is described in a workman following an industrial accident. The author says that this disease is more frequent than is generally believed because it usually results from a slight trauma which is not taken very seriously or watched very carefully and repeated roentgen examinations are not made. It is this lack of roentgen examination that leads to the disease not being recognized and to a diagnosis being made late if at all. But because of its localization at the knee-joint the disease is very important from the point of view of indemnity for industrial accidents and it is also rather serious because of its possible sequels—calcification and impairment of joint function. It is of course impossible, as in other industrial accidents, to pass definite and exact judgment on the amount of loss of working capacity caused; but at any rate the author thinks that greater compensation should be granted than has usually been given heretofore; generally the judgment given has been 5 to 10 per cent, at most, of the total working capacity. In this case, which was tried before one

of the higher courts, the indemnity granted was 15 per cent of the total working capacity.

Master, Arthur M., and Oppenheimer, Enid T. A study of obesity; circulatory, roentgen-ray and electrocardiographic investigations. *J. Am. M. Ass.*, May 18, 1929, xcii, 1652–1656.

The author has recorded the following results in the study of 97 cases of obesity.

The obese person usually complains of dyspnea, fatigue, palpitation, dizziness, and headache. With a loss of weight, the only treatment being a reduction of the caloric intake, these symptoms disappear.

Sixty-seven per cent of the cases showed hypertension. An accelerated pulse rate is commonly present. In general, the more the overweight, the greater the hypertension. With loss in weight, a corresponding fall in the blood pressure and pulse rate occurred.

With advancng years the blood pressure of obese patients increases. Apparently the longer the duration of the obese condition, the higher the blood pressure.

Under thirty years of age, the obese are somewhat more efficient than the average, suggesting that a moderate overweight in the young is a slight advantage.

Teleroentgenograms were taken in 73 cases. They show asthenic or hypersthenic habitus, elevation of the diaphragm and an enlarged, widened heart, with a hypertrophied left ventricle and a hazy lower left border obscured by apical pericardial fat. With reduction in weight, these characteristic signs disappear.

The electrocardiograms in obesity show a sinus arrhythmia, left ventricular preponderance, and inversion of the P and T waves in lead 3. With loss in weight, these changes disappear.

It is clear, therefore, that there exists in the obese person a distinct circulatory embarrassment, as proved by the abnormalities of the blood pressure, pulse rate, roentgenogram, and electrocardiogram, and by the diminished capacity for work. It is not difficult to understand why the fat person is a poor surgical risk, and why his mortality in pneumonia, nephritis, and heart disease is higher than the average.

These facts give ample explanation for the distinct improvement commonly observed on reduction in weight in patients with valvular disease of the heart, hypertension, and coronary artery disease.—*E. P. Pendergrass.*

Meda, Giulio. Roentgen study of invagination of the intestine. *Radiol. med.*, Aug., 1929, xvi, 821–839.

A detailed description is given of the different pictures that may be seen in invagination of the intestine, illustrated by roentgenograms and diagrammatic sketches. In practical roentgen examination invaginations may be divided into two classes: hypertonic ones with a penetrable sheath and hypotonic ones with an impenetrable sheath. This is the classification given by Castronovo but the author does not agree with Castronovo that the hypertonic forms are caused by tumor of the intestine, as there may be intense impregnation of the sheath in tumor also, as seen in one of the cases which the author describes. In the hypertonic forms there may be either a distinct transverse arrest of the opaque column, or a concave arrest, which suggests the diagnosis, or the pincers-shaped picture which is pathognomonic. In some cases, which however are quite rare, there is also injection of the intussusceptum with a sudden decrease in the caliber of the barium column. On passing by degrees to the hypotonic forms there may be the picture of an opaque mantle covering the invaginate or abundant impregnation of the sheath with a more or less evident defect of central filling and with the possibility also of a late formation of spiroid or accordeon-shaped pictures which are very characteristic. In many cases the irrigation may bring about complete disinvagination and also show a lacunar picture of the cecum, as in one of the author's cases, a picture which may be due to the tumor causing the invagination. Signs that are of great interest in a roentgen examination are absence of the cecum and ascending colon, emptying of the small intestine into the large intestine at an abnormal site with possibly a portio-shaped picture, a conical stenosis in the shape of a bird's beak of the last loop of the ileum, possible injection of the intussusceptum in the form of an opaque band or retrograde impregnation of the sheath with spiroid or rosette-shaped pictures. When there is perforation of the intussusceptum there may be direct passage of gas or intestinal contents into the proximal part of the sheath; but the presence of gas at this site is not necessarily a symptom of perforation.

Muzii, Mario. The roentgen diagnosis of some cases of external compression exercised on the stomach and duodenum. *Radiol. med.*, July, 1929, xvi, 674–686.

The author describes and illustrates with roentgenograms a number of cases of various conditions in which pressure is exercised from outside on the antrum or lesser curvature of the stomach or the duodenum. They

include cases of cyst of the pancreas, tumor of the head of the pancreas, abnormal deposition of fat in the gastro-hepatic ligament, calcified echinococcus cyst of the left lobe of the liver and primary tumor of the liver. He considers them with a view to determining whether it is possible to establish a uniform roentgen symptomatology for external pressure exercised on the stomach and duodenum. He concludes that this is not possible but as there are many affections quite different in nature and site that present very similar roentgen pictures a complete and minute roentgen study should be made in every case and by carefully considering it in connection with the clinical symptoms an exact or at least a very probable diagnosis may be made.

Pescatori, Guido. Cecal signs of chronic appendicitis. *Radiol. med.*, July, 1929, xvi, 693–715.

The author calls attention to the great importance of studying certain indirect signs caused by changes in the cecum and the last loop of the ileum in diagnosing chronic appendicitis. The changes in the cecum may be functional, that is, caused by hypertonia and hypermotility due to stimulation of the vagus nerve, or they may be organic, that is, caused by traction exercised on the cecum by the appendix fixed by adhesions or by peritoneal bands, or there may be a combination of functional and organic lesions. There are such remarkable differences in the appearance of the intestine in normal subjects or even in the same subject at different times that it is hard to attribute any given appearance to any special anatomical change and the author recognizes this fact; but in spite of that, the ileocecal signs may be of considerable importance when they are accompanied by clinical signs of appendicitis.

Brief histories accompanied by roentgenograms are given of 12 cases of ileocecal changes, either functional or organic, in cases of appendicitis verified by operation. The cecum was snail-shaped, ox-heart shaped, rectangular, polygonal or irregular in form, with the inner contour marked by a straight line, lacunar in appearance with deviation of its base by traction, spasm of the sphincter, stasis of the ileum from stenosis or spasm of the sphincter, dilatation of the lower end of the ileum, preampullar spasm, etc. He concludes that in the diagnosis of chronic appendicitis an extremely careful study should be made of the whole ileo-cecal region.

Porta, Remo. Unilateral renal symphysis and crossed dystopia of the kidney. *Arch. di radiol.*, Mar.-Apr., 1929, v, 400–415.

Unilateral renal symphysis is a congenital anomaly of development in which the two kidneys are fused but instead of being situated symmetrically on the two sides of the spinal column as they are in horse-shoe kidney they are low down in one flank, almost in the pelvis. In crossed dystopy of the kidney the kidneys are displaced in the same way but instead of being fused they merely lie side by side in the one flank. One ureter crosses the spinal column to reach its kidney pelvis.

The author describes a case in a woman aged twenty-two. About two years ago she began to have digestive symptoms with a feeling of distention of the stomach after eating and later dull pain in the right flank which increased on effort and fatigue and stopped on rest. Sometimes the pain radiated into the lumbar region and toward the pubis. The roentgenogram showed the right kidney at the level of the 3d, 4th and 5th lumbar vertebrae, that is, a little lower than normal. There were 4 orders of calyces which were elongated and the upper one extended toward the spinal column instead of outward as normally. There was moderate dilatation of the ureter but its course was normal. The left kidney lay near the right; the filling of the peduncle and calyces was incomplete. The left ureter crossed the spinal column to reach the kidney pelvis. There was a kink in the upper part of it. There was hemisacralization of the 5th lumbar vertebra. A detailed roentgenogram showed that the two kidneys were not fused. This is shown better by pyeloscopic examination which this patient refused. It was questionable whether the pain was due to the anomaly itself or to some secondary complication. As the pain had only developed within the past two years while the anomaly had existed all the patient's life it seemed probable that there was some complication, but the pain seemed to be sufficiently accounted for by the kink in the left ureter and a bilateral hydronephrosis. The patient was discharged and medical treatment advised.

Raviola, Bona, A case of biparietal senile disease. *Arch. di radiol.*, Mar.-Apr., 1929, v, 416–424.

In 1768 Köhler described a characteristic appearance of the skull in old people consisting of a special symmetrical depression in the parietal bones between the sagittal suture and the parietal eminences. The author reviews the literature of the subject from that time up to a case published by Casati in 1926 and describes a case of his own in a woman aged sixty-one. The roentgen picture in this case showed characteristic flat depressions in the flat bones

of the skull surrounded by halos of rarefaction of bone with the vessels of the diploe and the arterial sulci particularly prominent. He concludes that this appearance supports the theory that this lesion is a manifestation of an involutive process of senility brought about by various neurotrophic causes and changes in the circulation without infectious or mechanical factors.

Rollo, S. Flat-foot and congenital anomalies of the skeleton. *Arch. di radiol.*, Jan.-Feb., 1929, v, 112–116.

The patient was a boy of four who on the right side presented absence of the fibula, atrophy and an extreme degree of valgus of the foot and on the left marked flat-foot in slight valgism which was painless. He had had the deformity on the right since birth; that on the left had only developed within the last two years and had increased. The roentgen picture on the left side showed flattening of the arch, fusion of the astragalus with the calcaneus by a bridge of bone which occupied the whole sinus, atrophy of the navicular and head of the astragalus and fusion between them and probable fusion of the cuboid with the anterior calcaneus, suggested by the forward protrusion of the latter, though there was no trace of a boundary between the two bones; the structure was uniform throughout but on the right there was a trabeculation indicating the joint space. The body of the astragalus was atrophied and flattened and there was no cuneiform.

Few cases of flat-foot associated with such congenital anomalies have been described. The author urges careful roentgen examination of all cases seen in the future and thinks it will often be advantageous to use an oblique projection instead of a lateral and anteroposterior one. Such examinations will make it possible to differentiate between flat-foot from congenital anomaly and the tarsalgias of adolescence and will aid in determining the cases in which effective treatment is possible.

Salotti, Adelchi. The roentgen picture of the canal of the hypoglossal nerve. *Radiol. med.*, July, 1929, xvi, 669–674.

This description of the topographical anatomy of the canal of the hypoglossal nerve is accompanied by roentgenograms showing the course of the canal. Salotti is the first to have made a roentgen study of the subject. The projection which he proposes is an occipitoorbital one with its center at the boundary between the internal and middle thirds of a curved line connecting the external occipital protuberance and the auditory canal. The orbit, mandible, nose and chin of the subject rest on the plate. In this way the canal of the hypoglossus is shown quite clearly against the mandible. The canal may be single or multiple, round or oval. Sometimes the outlines of the canal are distinct presumably because the internal and external foramina are superimposed, sometimes it has a double outline presumably from difference in the size of the two foramina, sometimes it is indistinct because of the presence of fibrous septa. The study is interesting as showing that the canal is sometimes multiple and suggesting that certain obscure laryngeal syndromes may be due to variations in this canal.

Santoro, Mario. Curious roentgen finding in calcified brain tumor. *Radiol. med.*, July, 1929, xvi, 715–722.

Roentgenograms are shown of the skull of a girl eleven years of age who had a calcified brain tumor. In these roentgenograms, aside from the signs which are common to all brain tumors from increased intracranial pressure, the most striking point was the peculiar manner in which the calcium in this tumor was arranged. This peculiar arrangement, which suggested the arrangement of the depositions of calcium in the walls of calcified vessels, such as are often seen in the veins of the legs of old people, led the author to believe that this might be a calcified vascular tumor. On operation and puncture of the tumor blood was found. When the brain substance had been incised to a depth of about 3 cm., the examiner's finger entered a little cavity lined with a number of calcareous granules. The surgeon decided it was a blood cyst, but roentgen examination after the operation showed that many of the calcareous structures were still intact. It was evident that there were other cavities with calcified walls that had not been examined. The patient was seen four months after the operation. The clinical symptomatology was improved a little but the intracranial calcifications still existed.

Scott, W. J. M. Massive atelectasis and postoperative pneumonia. *J. Am. M. Ass.*, July 13, 1929, xciii, 101–103.

The prevention and treatment of postoperative pulmonary complications are studied in this paper. The author has followed a series of cases for over a period of two years, and gives a table of his findings. From this we learn that routine hyperventilation with carbon dioxide during or at the end of operation has greatly lessened the incidence of massive atelectasis, and probably also other postoperative pulmonary complications.

Therapeutic hyperventilation when given early in the cases in which massive atelectasis does develop produces immediate benefits, and when this is followed by placing the patient on the unaffected side, the uncomplicated cases clear up within a short time. The patients treated in this manner did not have their symptoms for more than one or two days, whereas previously the serious symptoms often extended over a week or more.

The author has no statistical evidence of the benefit of hyperventilation in postoperative pneumonia but it is his belief that postoperative pulmonary complications without cardiac displacement are similar in origin to those studied, and there is assurance that such cases show at least symptomatic benefit.

Prophylactic hyperventilation with carbon dioxide is recommended for patients in which the incidence of postoperative pulmonary complications is high.—*E. P. Pendergrass.*

Sever, James W. Abscesses in tuberculosis of the spine. *J. Am. M. Ass.*, June 1, 1929, xcii, 1822–1824.

In a recent study of 100 cases of tuberculosis of the spine, 15 cases showed a psoas abscess clinically and 14 were found by roentgen studies, the incidence being 29 per cent.

The duration of the disease does not bear any real relation to the formation of an abscess. Calcification in an abscess is at least a sign of age and is interpreted as evidence of healing. The abscess may occur early in the disease or late, usually late. Tuberculosis is essentially a destructive process, and there are usually waste products and some fluid present. In large destructive lesions multiple abscesses may be present. When there is extensive bone production, the spinal cord may be encroached upon resulting in paraplegia either transient or permanent.

The size and shape of the abscesses depend largely on the restricting influence of the anterior common ligament of the vertebral column. In the cervical region they may encroach on the pharynx, esophagus or trachea. In the dorsal region, they rarely come to the surface and are discovered by the roentgenogram. They are usually fusiform. In the lumbar region the abscess may be palpated in the abdomen or iliac fossa. The abscess in the dorsal region may affect a number of the vertebrae due to the inflammatory process and secondarily to the transmitted pulsation from the cardiac impulse.—*E. P. Pendergrass.*

Stoloff, E. Gordon. Pathologic changes in the large interlobar fissures in children. *Am. J. Dis. Child.*, July, 1929, xxxviii, 75–83.

In a former communication Stoloff suggested a method for the roentgen study of the large interlobar fissures which was cited in German literature by Holzknecht, later by Eisler and by Wimberger, and was elaborated in detail by Fleischner. This method is not in common usage, and for this reason he presents cases to illustrate the technique which deserves reintroduction into American usage.

The left interlobar and the right interlobar fissures are described in detail. Stoloff calls attention to the fact that the interlobar surfaces are to be thought of as surfaces, and these surfaces are not plane. If the great fissure markings as described anatomically are projected on a flat surface, then there will be seen a propellor-like figure, as described by Deitlen, or a "figure 8." The figure on the left side has longer and narrower loops.

The pleural coverings of the fissures may become involved secondary to pneumonia, rheumatic cardiac disease, tumors in the thorax and tuberculosis. In tuberculosis, because the primary focus usually lies subpleurally, a concomitant involvement of the pleura is found, manifesting itself as an adhesive pleuritis close to the side which shows a traction toward the infection. This pleuritis may be limited to this area or may extend over the entire surface of the lung. The reaction may be fibrinous, serous, hemorrhagic or a combination of these types. Exudation is of varying intensity. Healing occurs with localized or extensive adhesions; the process may be widespread so as to lead to synechiae of the pleurae. If a caseous focus perforates the pleural cavity, a caseous pleuritis will result; in such instances, healing may be accompanied by calcification and even ossification. The condition usually found is a localized fibrinous pleurisy. Because of their location near the pleurae and frequently within the fissures, the lymph glands, like the primary focus, may cause pleurisy of the mediastinum and interlobar fissures.

Roentgenoscopic examination is regarded as an indispensable preliminary to the roentgenographic examination as it permits a study of the respiratory movements in various positions which is not permitted by roentgenography alone. The usual anteroposterior position permits, because of the anatomical characteristics, a visualization of the small fissure between the right upper and middle lobes, since this fissure lies practically horizontal to the central beam of the tube, and permits also a visualization of the azygos fissure. The great interlobar fissures, in the usual anteroposterior position may fail to reveal interlobar disease unless it is extensive. If

the fissure is rotated on its axis so that the central beam passes through the entire length of the fissure, an impression of any pathological condition present, even if it is of limited extent, is made on the roentgenogram. In children who cannot cooperate this result can be secured by placing the tube at about the level of the first or second dorsal vertebrae and the film relatively low, inasmuch as the impression in this case is cast low on the film. A lateral position is also of great assistance when high voltage is used, so that any possible pathological change in the fissure may be seen through the shadow of the heart. In older individuals rotation of the fissure on its axis can be secured by telling the patient to hold his shoulders back and stick his abdomen forward as far as possible, thus achieving a lordotic position. The tube is then placed behind the patient at about the level of the fourth or fifth dorsal spine, and the film is placed opposite the same point. Not infrequently there is a haziness of the lung field in the region of the hilus, the nature of which does not become clear till the examinations in the lateral and the lordotic positions are utilized.

Stoloff presents a case of pleurisy of the large interlobar fissure associated with cardiac disease and another of interlobar pleurisy of the large fissure associated with tuberculous lymph glands, both illustrating the sparsity of physical signs and the absence of roentgen evidence when the routine anteroposterior positions were utilized. When the children were examined in the lordotic and also in the lateral positions, the presence and extent of the interlobar pathological changes became unequivocally evident.—*R. S. Bromer.*

Stott, H., and Lall, Raghunandan. Diaphysial aclasis (multiple exostosis) in Indians. *Brit. J. Surg.*, April, 1929, xvi, 633–640.

The authors report 7 cases of multiple exostosis now known, especially in England, under the more modern term of diaphysial aclasis. Six of the 7 cases were observed within a period of six months, 4 of these being in one family in which the hereditary tendency was marked.

They state that the condition is definitely removed from the category of bone tumors, and is due to a growth disorder of cartilage, whereby the cancellous bone laid down between the diaphysis and the epiphysis is imperfectly modelled by its lateral periosteal covering. The shafts of long bones grow by two distinct processes: (1) New cancellous bone is first laid down at the shaft extremities in the diaphysial line. Achondroplasia results when this process is defective. (2) In the second or modelling process, this cancellous bone is absorbed and gradually converted into the compact shaft bone with its medullary cavity. In diaphysial aclasis all long bones exhibit one and the same defect, namely, arrest of the modelling process. Hence the several outgrowths of cancellous bone, which especially arise where growth is most vigorous and prolonged, as is illustrated by the cases reported.

This disease does not arise in membranous bones or in bones formed in cartilage, but only in situations where the two processes of membranous and cartilaginous bone formation come into juxtaposition, especially where such a modelling growth is most marked, e.g., the diaphysial growing ends of the long bone, the growing margins of the ilium and the scapula, especially its vertebral border, the costochondral junctions, and both ends of the clavicle. In one case the roentgen rays showed some abnormal periosteal deposits along the shaft of certain long bones. Bland-Sutton states that the bones are often abnormally thick. The disease usually starts in childhood and ceases with skeletal growth. The diaphysial ends of the tibia and the fibula are often fused. Further growth of the distal end of the ulna is often deficient while that of the radius continues, whence the radius becomes "bent to a bow," the ulna serving as a "stretched string." The proximal end of the radius is sometimes dislocated and the external epicondyle of the humerus is detached.

The paper is illustrated with roentgenograms of the cases and contains a chart of the family tree of the family in which 4 of the cases occurred.—*R. S. Bromer.*

Talia, F. Organic and functional changes in the intestinal tract resulting from suppurated abdominal extra-uterine pregnancy. *Arch. di radiol.*, Mar.-Apr., 1929, v, 342–360.

Two cases of suppurated extra-uterine pregnancy are described in which the placenta was attached to loops of intestine. They were diagnosed by roentgen examination and the diagnoses confirmed by operation. The changes that took place in the intestinal tract after clinical recovery as a result of these placental insertions were also followed up roentgenologically. Both functional and organic changes were brought about in the intestinal tract. Functionally there was increased peristalsis throughout the digestive tract which the author attributes to the organic adhesions. In places the inflammation had caused seg-

mental stenoses and adhesions. The size of the abdomen was decreased because of the production of reparative and cicatricial tissue. These organic changes evidently acted on the vegetative nervous system and brought about the functional changes.

Talia, F. Beginning carcinoma of the valve of Varolius. *Arch. di radiol.*, Mar.-Apr., 1929, v, 361–380.

Two cases of beginning carcinoma of the ileocecal valve are described and the clinical and roentgen literature of the subject reviewed. It is quite difficult to make a differential diagnosis between tuberculosis, syphilis, carcinoma and ordinary inflammations of the ileocecal valve. In his two cases the author found the following signs of beginning carcinoma: (A) In the terminal loop of the ileum: (1) retardation of emptying; (2) residues of barium paste with ultimate emptying; (3) active peristalsis of the loop and in the terminal phase atony; (4) often irregularity, dilatation, spasm, etc. (B) In the ampullar part: (1) irregularity of form; (2) functional irregularity; (3) long apex, sometimes irregular and ordinarily not reaching the large intestine. (C) In the valve: (1) not visible roentgenologically (space between the ileum and small intestine); (2) there may be a few lines of contrast medium lining the valve region. (D) In the large intestine: (1) functional and organic irregularity in the valvular portion; (2) irregular cecum (often full) with stagnation and final emptying; (3) multiple spasms of the colonic sphincters; (4) functional irregularity and irregularity in the passage of the barium.

Thoms, Herbert. A new method of roentgen pelvimetry. *J. Am. M. Ass.*, May 4, 1929, xcii, 1515–1516.

Pelvimetry by a new roentgen technique has proved satisfactory in the hands of the author. The technique is as follows: The patient is placed in the semirecumbent posture. The relation of the superior strait to the sensitive film is established. The exposure is made and the patient removed. A special perforated lead plate is placed in the same plane as that occupied by the superior strait of the patient and a second flash exposure is made on the same film. On development of the film the landmarks are easily determined and the measurements are made directly in centimeters. The fine details of the technique are described with illustrations. The author in concluding states that the method is infinitely more accurate than any other used today.—*E. P. Pendergrass.*

Editorial. Roentgen pelvimetry. *J. Am. M. Ass.*, May 11, 1929, xcii, 1601.

Roentgen pelvimetry was first attempted by Albert of Dresden in 1896, subsequently, Budin, Vanier, Fabre, Fauchet, and Bouchacourt published papers on the subject up to 1900. Americans did not readily follow the early workers, because the early methods were unreliable. In 1922, Thoms first reported his experiences. These have been improved upon and lately he has published a most valuable method which is adaptable to routine use and should prove to be a great aid to the obstetrician in accurately predetermining the hazard of childbirth.—*E. P. Pendergrass.*

Utili, Volturno. Unusual foreign body found in the stomach. *Radiol. med.*, Aug., 1929, xvi, 785–789.

A young woman of twenty-five came to the hospital for a roentgen examination of the urinary tract. She was suffering from severe anemia and exhaustion and pain of a colicky type in the right upper quadrant of the abdomen. On making a roentgen examination the author was surprised to find an accumulation of foreign bodies in the stomach weighing 380 grams. It contained many needles, some of which had perforated the wall of the stomach and penetrated the neighboring tissues. She recovered completely following a radical operation. The author thinks no fixed rule can be followed when foreign bodies are found in the digestive tract but that each case must be given careful individual study and treatment.

Vietti, Marco. A new roentgen sign of posterior luxation of the atlas. *Radiol. med.*, Aug., 1929, xvi, 807–814.

A new indirect sign of posterior dislocation of the atlas is described. It consists of a posterior deviation of the gray paravertebral ribbon formed by the tissues that lie between the zone produced by the air contained in the pharynx and the anterior surface of the bodies of the vertebrae. Normally this ribbon follows the course of the spinal column with great regularity while in anterior dislocations it appears to be displaced forward. Anatomically this picture must be caused by the occipito-atloido-pharyngeal ligament which is pulled backward in posterior dislocation of the atlas.

Viviani, Rodolfo. Dyschondroplasia. *Radiol. med.*, Aug., 1929, xvi, 737–775.

A detailed description is given of a case of dyschondroplasia in an unmarried peasant woman aged twenty-nine. In connection with this case Viviani discusses the views of different authors in regard to the etiology, pathogenesis

and pathological anatomy of this disease. There are several particularly interesting points about this case. It is unusual for an intracranial localization of the process to be found in a case diagnosed during life, the bone lesions were associated with angiomata of the skin and they were bilateral. A particularly striking point was that this patient showed both the bone lesions of ordinary dyschondroplasia and also exostoses and chondromas. These different changes were found close together in different parts of the skeleton. These facts confirm what other authors have seen and suggest that dyschondroplasia, multiple exostoses and multiple chrondromas are, at least quite frequently, manifestations of the same disease; so dyschondroplasia has a much broader meaning that has usually been given it by many authors. The fact that the lesions were bilateral and that a number of bilateral cases have been published in the literature leads the author to believe that Ollier's disease is only a variety of dyschondroplasia. He concludes that dyschondroplasia is congenital in origin and that it results from some unknown cause acting on the skeleton at a very early period of intra-uterine life.

Webb, Gerald B. The early diagnosis and early care of pulmonary tuberculosis. *J. Am. M. Ass.*, June 1, 1929, xcii, 1811–1813.

The roentgen examination is the only method available for detecting early pulmonary tuberculosis. Tubercle deposits which are found by the roentgen examination are considered by McPhedran as "latent" when there are no physical signs or symptoms that can be noted by physician or patient.

Further progress in eradicating tuberculosis depends to a large degree on the routine roentgen examinations of all young adults, especially those who have a family history of tuberculosis or who have been exposed to the disease.

In emphasizing the necessity for roentgenographic studies for the detection of the earliest lesions of tuberculosis, the well-known methods of physical examination must not be neglected. Percussion, palpation, and auscultation are still of service in the diagnosis.

Careful history taking is of the greatest importance. The patient should be questioned as to exposure, loss of weight, lassitude, sweats, frequent colds, hemoptysis, pleurisy, cough, hoarseness, nervousness, stomach upsets, menstrual irregularities, rectal abscess, and headaches. The examination of each patient suspected of having tuberculosis should be general and thorough. The ear, larynx, testicles, eyegrounds, anus, abdomen, and lymph glands should all be investigated.

Suspected persons must be placed at rest for at least ten days while temperature and pulse are studied.

Specimens of sputum should be studied, and if the first are negative, a number of specimens should be examined.

The Early Care. After a positive diagnosis of pulmonary tuberculosis is made, the patient should be put to bed for an indefinite period, preferably in a sanatorium. The sanatorium is necessary for education and if the patient's sputum is positive, there is enforced isolation from the family, especially from children.

Physicians must be unusually resourceful in maintaining morale and hope. Pulmonary tuberculosis has a great tendency to relapse. Two or three years of the most careful observation are necessary in all patients with pulmonary tuberculosis, and pleurisy with effusion.

Ten illustrations of various types of the disease are included in the article.—*E. P. Pendergrass.*

Witting, Vito. The roentgen picture of exudative and productive pulmonary tuberlosis. *Arch. di radiol.*, Jan.-Feb., 1929, v, 25–44.

The value of the classification of pulmonary tuberculosis into productive, exudative and mixed forms is generally recognized. But it is usually impossible to differentiate between them clinically and physicians have resorted to roentgenology in the hope of finding a means of differentiating definitely between them. Witting has treated a large number of cases and has compared the clinical data and roentgen findings during life with the roentgen, antopsy and microscopic findings after death. He concludes that the roentgen examination made by many authors, including his own, have been by no means decisive. They are of some value in prognosis in the cases in which the roentgen findings are very marked, but in the ordinary case and with the usual methods of examination they do not suffice for a differentiation between the different forms.

ROENTGEN AND RADIUM THERAPY

Strumia, M. M., On the generalized effect of radiations in myelogenous leukemia. *Am. J. M. Sc.*, May, 1929, clxxvii, 676–681.

The purpose of this paper is to present definite evidence in support of a conclusion reached by the author in a previous communication; "the mechanism of the action of

radium upon the leukemic foci is of a generalized as well as a localized nature." In other words, when radium is applied to any portion of the body, its effect is carried by the blood stream to the leucopoietic foci. Thus from a local application, a generalized action is obtained.

Two cases are reported. The first, a young white woman, with an early untreated myelogenous leucemia received two autotransfusions of irradiated blood. After each one of the transfusions blood changes occurred, in all respects similar to those obtained where radiations are applied to the body (long bones). A marked diminution in the size of the spleen was also obtained.

The second case was that of an adult negro with advanced myelogenous leucemia, who was given two radium treatments on consecutive days, the emanation tubes being applied over the lower thirds of both tibiae and the short bones of both feet. That the application had effect was evidenced by the sudden rise in the number of leucocytes, followed by a sharp drop, and by the conspicuous changes in the differential blood count. At autopsy, it was found that there was no hyperplastic bone marrow in either tibia, nor in the short bones of the feet, but only fatty aplastic bone marrow; also that there was no difference whatever between the bone marrow of the bones which had been irradiated, and of some that had not been irradiated. This was especially evident, comparing smears and sections of the lower third of the tibia irradiated, and the upper third of the tibia which had not been irradiated.

In the first case it is obvious that the irradiations as such or their effects were carried by the irradiated whole blood. In the second, it would be very difficult to trace a direct effect of the radium applications upon the bone marrow of the bones irradiated. The effect of radium emanations upon the hemoplastic foci must be explained on the ground that the radium emanations as such are carried by the blood or that they act through the production of leucotoxins, which are produced by the direct effect of the radium emanations upon the white cells of the reticuloendothelial system. In fact, in the second case there was no active bone marrow in the bones irradiated, and there was no difference between the portions irradiated, and those not irradiated.

Radium and roentgen rays affect the hemopoietic centers by an indirect generalized action rather than by a direct local effect. It is not yet clear whether this indirect effect is produced by the blood transfer of emanations to the bone marrow, or by the extramedullary production of leucotoxins, which are then transported to the bone marrow. In the treatment of myelogenous leucemia by radium or roentgen rays it is the dosage rather than the place of application that is important.—*R. S. Bromer.*

Vogt, E. The roentgen irradiation of inoperable ovarian carcinomas. *Strahlentherapie,* June 5, 1929, xxxii, 640–650.

Forty-one cases of malignant ovarian tumors were irradiated from 1922 to 1928. In 16 cases the irradiation was combined with radical operation; in 7 the operation was incomplete; in 13 (which were from the beginning inoperable) only a laparotomy with drainage of the ascites and biopsy was performed and 5 cases were so far advanced that not even laparotomy could be considered.

Three cases in which the effect of the roentgen irradiation was beyond doubt are described in detail. The following conclusions are reached: (1) Operability of an ovarian carcinoma can be determined only at the time of operation. (2) All cases should be operated upon first, even if it is only for the drainage of ascitic fluid and the partial removal of the larger tumor masses. (3) All cases should be irradiated postoperatively. The irradiation should be started within three to five days following operation. (4) In a few instances, which first proved inoperable, later following several series of roentgen treatments, a radical operation could be performed successfully.—*T. Leucutia.*

Wakeley, Cecil P. G. Tumors of the salivary glands. *Surg., Gynec. & Obst.,* May, 1929, xlviii, 635–638.

Wakeley describes one case of agiomatosis of the salivary gland which came under his observation together with several others collected from the literature. He also gives a short description of the adenomata. The paper for the most part is devoted to a discussion of the mixed tumors of the salivary glands, most common in the parotid. These tumors show a definite tendency to recur even after a long interval and are therefore considered by many surgeons to be potentially malignant. He quotes Burrow who considers that the most satisfactory method of treatment is operation combined with radium irradiation. He, himself, advises great caution in the employment of radium treatment and believes that only small doses should be employed at

operation. The radium tubes should be left in the cavity after removal of the tumor. Hs has seen 2 cases in which radium was used and complete paralysis of the facial nerve ensued. He reviews 52 cases of parotid tumor operated upon at King's College Hospital, and concludes that treatment by radium or deep roentgen therapy does not seem to lengthen life to any appreciable extent. Whatever the pathogenesis of the mixed tumors of the salivary glands may be, it is certain that recurrence after operation is common, and therefore these tumors should be considered as potentially malignant.—*R. S. Bromer.*

Wakeley, Cecil P. G., and Colwell, H. A. A note on thirty cases of carcinoma of the rectum treated by gamma radiation. *Lancet*, March 16, 1929, i, 553–554.

The experience in the treatment of 30 cases of inoperable carcinoma of the rectum by radium using the method developed by Neuman and Coryn of Brussels is given. There was a histological verification of the diagnosis in every case and all had a preliminary colostomy. The method employed consisted of the insertion of radium into the lumen of the bowel. The amounts of radium varied from 50 to 150 mg. This was enclosed in torpedo-shaped platinum-iridium containers 0.5 mm. thick. These were placed in similar cases of the same thickness, after which they were enclosed in a soft rubber tube before being inserted into the rectum. The filtration insured gamma radiation. The time of irradiation varied from twelve to thirty hours. The reaction obtained from such irradiation varied considerably and did not appear to bear any definite relation to the amount of radium used or the duration of irradiation.

In 8 of the 30 cases there was definite improvement noted. One of these patients lived fifteen months, 2 eighteen months and in 2 cases the growths became operable as the result of treatment and both patients lived three years following excision. One died from bronchitis and the other from heart failure. Best results were obtained from the use of 100 mg. for eighteen hours and 50 mg. for twenty-four hours.

From their experience the authors are of the opinion that when operative measures for the insertion of radium by the open method are inapplicable, the insertion of radium into the lumen of the gut may make the patient's condition more tolerable and under certain circumstances render a previously inoperable case operable.—*Karl Kornblum.*

MISCELLANEOUS

Bödecker, F. Contribution to measuring methods in skin therapy. *Strahlentherapie*, June 5, 1929, xxxii, 777–781.

The author, in a series of experiments, investigated the applicability of the absolute dose as measured by the Küstner apparatus (large model) in skin therapy.

It was found that the normal doses as indicated by Meyer correspond to the following values: unfiltered radiation (half-value layer 1.0–1.2 cm.) 300 r; lightly filtered radiation (half-value layer 1.6–1.8 cm.) 370 r, and filtered (1 to 4 mm. Al) radiation (half-value layer 2.0–2.5 cm.) 450 to 485 r.

The conclusion is reached that a schematic application of the skin unit dose of 550 r is not applicable for roentgen rays of all qualities.—*T. Leucutia.*

Braun, R., and Küstner, H. The physics of the thimble chamber. *Strahlentherapie*, 1929, xxxii, 550–581.

Since the majority of roentgen dosimeters are provided with thimble chambers, the authors undertook to investigate the dependence of these chambers on the quality of the roentgen rays. Due to the fact that Küstner's instrument (large model) measures all rays (from 180 kv., 2 mm. Cu. to 20 kv. unfiltered) in exact roentgen units this apparatus was used for the control of the measurements which were performed by the three electrometer method (previously described by Haas and Küstner).

The results of the experimentation are as follows:

1. Cellon and cellophan of equal thickness absorb roentgen rays of all qualities equally.

2. The construction of the floor of the thimble chamber as well as the material used for this purpose is of paramount importance. An open thimble chamber leads to escape of some of the primary electrons of the ionization chamber into the cable producing there an ionization which in case of hard rays results in a dependence on the wave length. On the other hand, amber or lead used as floor material may lead to considerable errors (these being especially marked in the latter case due to the so-called lead effect). In order to prevent the occurrence of such disturbances it is advisable to close the thimble chamber at the bottom by leaving, however, an air ring of 2 mm. width for the isolation of the electrode. The most suitable flooring is air wall material protected with lead on the sides and on the cable end. In practice cellophan

coated with graphite (of 0.025 mm. thickness) forms the best air wall material.

3. Of similar importance is the construction of the protective cable connecting the thimble chamber to the measuring instrument. If a lead sheet 3 mm. thick and without inner cover is used for the purpose of protection an error as high as 100 per cent may be committed (in case that the cable is 28 times as long as the chamber). If the lead sheet is 5 mm. thick and without inner cover and if the cable is about six times the length of the thimble chamber, only 1 per cent additional ionization results. If the 3 mm. lead sheet is covered with 0.1 mm. aluminum on its inner surface, the protection of the 3 mm. lead sheet becomes equal to that of the 5 mm. sheet and the protection of the 2 mm. sheet equal to that of the 4 mm. sheet; in other words, the addition of an inner coating of 0.1 mm. aluminum replaces 2 mm. lead (assuming that the lead is at least 3 mm. thick).

4. The material of the pencil electrode is of no less influence on the total ionization. If the pencil is not constructed of air wall material the emission of electrons from the pencil leads to a dependence on the quality of the roentgen rays which has a maximum value for rays of medium hardness. On the other hand, the shadow effect of the pencil results in a dependence of the ionization on the direction of the beam which in turn has a maximum value for the soft radiation. The ideal inner electrode therefore is a hollow pencil constructed of cellophan (of 0.025 mm. thickness) and coated with graphite of a few hundredths millimeter wall thickness.

5. The material most suited for the construction of the walls of the thimble chamber is likewise cellophan coated with graphite. When one uses the above-mentioned hollow electrode a cellophan thimble chamber of 0.025 mm. wall thickness is entirely independent of the wave length (between 180 kv., 2 mm. Cu and 20 kv. unfiltered). If, however, the thickness of the cellophan is increased the chamber develops a dependence on the wave length for the softer rays; a chamber of 0.02 mm. cellophan, for example, shows a quality independence only as far down as 50 kv., 1 mm. Al, while with 20 kv. unfiltered there is an error of 8 per cent.

6. The influence of the aluminum coating on the cellophan chamber was determined both for the roentgen-ray absorption and electron emission. First the posterior half of the chamber was coated on its internal surface with aluminum foils of different thickness and the electron emission of the aluminum measured. Then the anterior half of the chamber was coated internally and both the electron emission and the absorption of the aluminum were determined. It was found that chambers may be constructed of other composition than air wall material as, for example, aluminum, and that by coating the inner surfaces of these chambers with cellophan-graphite an entire independence on the wave length may be obtained (at least within the limits of deep roentgen-ray therapy).

7. The influence of the thickness of the air wall material on the amount of ionization and thus on the dependence on the wave length was determined for thicknesses of from 0.02 to 2.2 mm. Between 180 kv., 2 mm. Cu and 100 kv., 0.3 mm. Cu, there is no dependence of the thickness of the walls on the wave length, However, for rays softer than 100 kv. and 0.3 mm. Cu there is a diminution of the ionization due to the absorption of the walls.

8. The ideal air wall chamber which no doubt will be constructed in the near future will possess walls of beryllium coated with a very thin layer of air wall material. Beryllium is a good conductor of electricity, very solid and absorbs roentgen rays of all wave lengths four times less than the air wall chambers used up to the present time. A beryllium chamber of 0.2 mm. thickness would be entirely independent of the wave length as far down as 30 kv. unfiltered and would show with 20 kv. unfiltered an error of only 4 per cent.—*T. Leucutia.*

Braun, R., and Küstner, H. The physics of the thimble chamber, II. The saturation of thimble chambers. *Strahlentherapie*, 1929, xxxii, 739–758.

If a dosimeter is not saturated, a too small intensity of the radiation is measured and consequently there is danger of burns. Because of this fundamental importance of the saturation the authors undertook a series of experiments in order to determine the different factors which may influence the saturation of the thimble chambers.

The roentgen apparatus for the purpose was a Stabilivolt with a Siemens and Halske deep therapy tube adequately protected by lead walls of 5 mm. thickness. The highest intensity of the radiation applied was 80 R per minute (1 R, German, = 1.066 International r), with 164 kv. max., and 8 ma. In some of the experiments 60 R per minute (162 kv. max., 6 ma.), 40 R per minute (132 kv. max., 5 ma.), and 20 R per minute (110 kv. max., 3 ma.)were used.

The ionization measurements were performed by the zero method with the aid of a

Lutz–Edelmann electrometer. The general principle of the method (which is described in detail) is that the ionization of the test thimble chamber is compared to the ionization of a standard thimble chamber, both chambers being connected to the same electrometer and being irradiated at the same time. If the ionization in the two chambers is equal, the electrometer is at the zero point. If the ionization in the test chamber is larger (than that of the standard chamber) the thread of the electrometer deviates towards the positive side, while if the ionization of the test chamber is less the thread deviates towards the negative side. By a suitable lead aperture placed in front of the standard chamber and which can be controlled with mathematical precision, it is possible to gradually increase or decrease the size of the radiation beam and thus the ionization of the standard chamber until the zero point of the electrometer is reached. In this manner a quick and easy comparison of the two chambers and a very accurate estimation of the factors pertaining to the saturation of thimble chambers is possible.

The following factors were investigated:

1. "Pencil Effect" (Jaeger and Halberstaedter). The saturation is the more complete, the smaller the distance between the end of the axial pencil electrode and the end of the chamber.

2. Influence of the form of the end of the chamber (flat or hemispherical roof of the chamber). Of two chambers of equal length, diameter and pencil distance but of flat and hemispherical roofs, a better saturation is obtained in the chamber with the hemispherical roof.

3. Influence of the length of the chamber. Of two chambers of equal form, diameter and pencil distance but of different lengths, a more complete saturation is obtained in the longer chamber.

4. The influence of the diameter of the chamber. Of two chambers of equal form, length and pencil distance but of different diameters, a more complete saturation is obtained in the chamber with the smaller diameter.

5. Influence of the form of the pencil. The best saturation is obtained with the type of pencil used in the Siemens roentgen dosimeter.

6. Quantitative measurements. The saturation deficit (in per cent) for various chamber tensions (in volts) was determined in thimble chambers of different form (flat or hemispherical roof), length, diameter and with different pencil-roof distances by using a radiation intensity of 80 R per minute. It was found, for example, that if the pencil electrode is of 2 mm. diameter and if the distance between the end of the pencil and the roof of the chamber is 2 mm., a tension of 200 volts is sufficient to produce an ionization error which is not greater than 1 per cent, while if one allows 2 per cent error a tension of only 150 volts is necessary. However, if the distance between electrode and end of the chamber is 6 mm., 300–350 volts are necessary for an ionization error of 1 per cent and 200 volts if one permits an error of 2 per cent. For the above reasons one should not use a distance between the electrode and the end of the chamber which is greater than 2 mm.

7. Influence of the intensities of roentgen rays on the saturation. The measurements (in 6) were repeated also with 20, 40 and 60 R per minute intensities. It was found: (*a*) that the saturation is the poorer, the higher the intensity of the roentgen rays; (*b*) that the saturation is more favorable in the hemispherical chambers than in the chambers with a flat roof; (*c*) that the saturation is the more complete, the smaller the distance between the pencil electrode and the end of the chamber, and (*d*) that the saturation is the best in the type of electrode used in the Siemens roentgen dosimeter.

8. Estimation of the errors of dose measurements due to incomplete saturation. For intensities higher than 40 R per minute and for tensions higher than 56 volts, an error due to incomplete saturation is made in the dose measurements which shows a linear ascendance with increasing intensities. This permits the estimation of the error (for higher intensities) by means of an extrapolation formula.

9. The error in the depth dose due to incomplete saturation. The incomplete saturation results also in an error of the percentage depth dose (Jaeger and Halberstaedter) which is the greater, the higher the roentgen intensities applied.—*T. Leucutia.*

Brummer, Karl. A short communication on the peculiar behavior of nitrogen during its ionization by roentgen rays. *Strahlentherapie*, June 5, 1929, xxxii, 759–760.

By providing an ionization chamber with an inlet and an outlet tubing so that a circulation of the air could be produced during the period of actual measurements and by replacing the air with different gases, it was found that while oxygen and carbon dioxide show the same behavior during their actual ionization by the roentgen rays, the nitrogen shows an ionization curve which is very peculiar. The curves are graphically plotted. This

communication was made in order to attract the attention of physicists to this particular behavior of the nitrogen during the course of ionization.—*T. Leucutia.*

Farrell, John T. Jr., Langan, Paul C., and Burgess, Gordon. A roentgen ray study of a group of long distance runners; with special reference to the effects of exercise on the size of the heart. *Am. J. M. Sc.*, March, 1929, clxxvii, 394–398.

This roentgenographic study was undertaken to determine the effects of long distance running in 23 athletes. In a race from Los Angeles to New York, these runners averaged 41 miles daily for eighty-four consecutive days. Since it was only possible to make roentgenographic exposures of the runners after the race, the data thus obtained were compared with normal standards. The exposures made three days after the end of the race were as follows: stereoroentgenograms of the chest at a distance of 4 feet, posteroanterior and lateral teleroentgenograms at 7 feet, lateral views of the ankles and knees, anteroposterior views of the legs, forearms and wrists.

Conclusions: (1) A roentgenographic study of a group of long distance runners was made to determine the effect of prolonged effort on the heart, lungs, bones and blood vessels. (2) The lungs were found to be essentially normal. (3) The bones, except for certain arthritic changes, were normal. (4) The blood vessels were visualized only in the older runners. (5) In 13 runners, the heart appeared to be definitely smaller than normal, in 5 runners the hearts were within normal limits, and in 5 instances the hearts according to the predicted diameters, showed an increase in size. According to the so-called cardiothoracic ratio, only one heart was increased in size. (6) The data as a whole suggest that the immediate effects of long distance running are inconsequential, since all of the changes noted may be found in individuals of similar ages without symptoms.—*R. S. Bromer.*

Fetterolf, George, and Sprenkel, Edward E. A comparison of the outline of the frontal sinus in vivo, as shown by transillumination and the roentgen rays. *Arch. Otolaryngol.*, Feb., 1929, ix, 181–184.

The authors selected a small group of medical students and subjected the frontal sinuses to transillumination, placing the light bulb at the usual place, the upper inner angle of the orbit. Then the apparent upper margin of the sinus was outlined on the skin with a small brush dipped in an opaque paint. The lateral margin was frequently so vaguely defined that it was impossible to locate it with any degree of accuracy; therefore no constant attempt was made to indicate it. After the painting the patients were taken to the roentgen-ray laboratory and films were made.

The result was interesting. The frontal sinuses were decidedly smaller than they appeared to be on transillumination, and on the average they extended up into the frontal bone from one-half to three-quarters of an inch (1.27 to 1.90 cm.) less high than transillumination seemed to indicate. The practical value of these observations only time and experience will show. To conceive the frontal sinuses as they really are, one must deduct one-half to three-quarters of an inch in the vertical direction from their upper outline as shown by transillumination.—*R. S. Bromer.*

Jona, M. Comparison of the radium and roentgen doses with a roentgen dosimeter. *Strahlentherapie*, June 5, 1929, xxxii, 775–776.

An attempt was made to compare the radium doses with roentgen doses in absolute R units as measured with the Wulf ionometer. It was found that by using a brass filter of 2.6 mm. thickness, 1 mg-el-hr/cm. = 6.5 R and thus 1 R = 0.156 ± 5 per cent mg-el-hr/cm. The erythema dose was found to be: 400 mg-el-hr./cm. = 2600 R, which indicates that the skin tolerates a dose three to four times larger of gamma rays than of the hardest roentgen rays. The conclusion is reached that the tolerance of the skin towards radiation is the greater, the harder the radiation.—*T. Leucutia.*

Jorstad, Louis H., and Lane, Clinton W. Gross and microscopic changes in the skin produced by x-rays and by lipoid solvents. *Arch. Dermat. & Syph.*, June, 1929, xix, 954–967.

This paper is a report of experimental work on rats which were subjected to roentgen exposures and to repeated paintings with tar preparations over a long period of time, with observations of the gross and microscopic changes in the skin produced by these experimental methods. By varying the time of exposure and by transmitting the rays through an opening 1 cm. in diameter, the remainder of the rat being protected, various degrees of roentgen reactions of the skin were produced. A large series of animals was started so that one animal from each series could be killed every thirty to sixty days throughout the experiment, for study of progressive changes. Weights were taken every ten days to two weeks for the purpose of comparative data. The area of the skin exposed to the roentgen rays or painted with the tar preparations

was removed, fixed in formaldehyde, dehydrated and stained with hematoxylin eosin. The whole procedure was uniform throughout.

The rats subjected to the roentgen rays and also those receiving the painting with the tar preparations were fed either on a dietary high in vitamin A, or on a dietary low in vitamin A, and the remainder, a majority of the animals, on a well-balanced dietary. A third series of rats was subjected to roentgen exposure until well-marked burns resulted, and these exposed areas were painted twice weekly with tar preparations.

The results are given in great detail by the authors, and they conclude that active precancerous lesions as shown histologically, can be produced in the skin of the white rat by repeated painting with a diluted tar preparation. The same type of lesion is produced by a single exposure to unfiltered roentgen rays, or by combining the two procedures. In observing the histologic changes produced by these procedures at different intervals throughout the period of experiment, further evidence was gained that coal tar, allied substances such as mazola oil, paraffin oil and neat's foot oil and roentgen rays act similiarly in inducing a malignant condition. They act as lipoid solvents.—*R. S. Bromer.*

Knott, F. A., and Watt, W. L. Some effects of deep x-rays upon the cells of the blood. A preliminary note on a phagocytic test. *Brit. M. J.*, March 23, 1929, i, 542–543.

Experiments were conducted to observe in vitro the effects of the rays of deep roentgen therapy upon the living white cells of the blood. The hardest rays possible to obtain were used.

To show that whatever injury may occur to the leucocytes during deep therapy is not due to the direct action of the rays themselves, but to secondary rays thrown out by all elements which obstruct the path of the original rays, the following experiments were performed: Freshly drawn, oxalated blood was placed in a small chamber situated in a large block of paraffin wax. Intense irradiation for 1½ hours produced no effect upon the blood cells. When the chamber containing the blood was surrounded by a layer of blotting paper, soaked in a solution of metallic salt, damage to the cells could be noted after only fifteen minutes' irradiation. The more intense the secondary radiation produced, the more quickly were the white cells affected.

To determine the damage done to the cells by irradiation, small samples of blood were withdrawn from the chamber before and at intervals during irradiation. Then films of the blood were spread and examined by all the usual and several special histological methods No changes could be noted in the cells. If kept at laboratory temperature, under sterile conditions, for three days, the irradiated cells showed nuclear degeneration more quickly than the normal cells. The difference, however, was not sufficiently sharp to make the method satisfactory. Also blood counts failed to reveal any reduction in the red or white cells.

Failing thus to observe any deleterious effect upon the white cells, some biological method was sought. The phagocytic power of the leucocytes gave promising results. When a given quantity of an emulsion of staphylococci was added to samples of normal and leucemic blood, it was found that there was a complete loss of all phagocytic power in the polymorphonuclears within thirty-five minutes, that this loss was quite permanent, and that the effect was manifest in about the same time whether in normal or leucemic blood.

The phagocytic test was then used upon blood drawn from leucemic patients immediately and for some hours following irradiation. From the observations made, it was concluded that the immediate fall in the white count in these patients is due directly to the lethal effect of the secondary radiation upon the cells themselves, but that the more gradual fall which occurred later and continued for a time, was the result of the depressing effect upon the white cell producing mechanism, the reticulo-endothelial system. The same results were obtained when blood from patients receiving irradiation, but having a normal blood picture, was tested.

The authors believe that the phagocytic test will prove of definite clinical value. It explains the well-known fact that actively septic patients are not good subjects for irradiation. The test applied to such patients would indicate how much, if any, irradiation could be given. Also it is possible by this test to predict the fall in the white count during irradiation, thus giving a method by which dosage can be controlled. According to the authors, irradiation may well be stopped at a point where not more than 25 per cent of the patient's polymorphonuclears have lost their phagocytic power.—*Karl Kornblum.*

Martin, Lay, and Hill, J. H. Mercurochrome as a biliary antiseptic, as a means to visualize gall-bladders, and as a possible form of treatment in cholecystitis. *Am. J. M. Sc.*, May, 1929, clxxvii, 710–721.

The conclusions of Martin and Hill on mercurochrome as a biliary antiseptic, etc., are as follows:

1. After oral administration of mercurochrome to the point of salivation in 13 individuals: (*a*) The bile was never bactericidal or inhibitory and never contained visible traces of the dye. (*b*) The treatment had no alleviating effects upon the symptoms of 8 individuals with cholecystitis.

2. Following intravenous injection of mercurochrome in man, the dye may be demonstrated in the bile siphoned out through a duodenal tube in eighteen to twenty-three minutes.

3. This bile is bactericidal and contains mercury.

4. Eighteen to twenty hours after intravenous injection, mercurochrome may be obtained by duodenal drainage. It apparently can be stored in the gall-bladder.

5. This bile is bactericidal and contains mercury.

6. Eight individuals with cholecystitis have received mercurochrome intravenously. Three were not helped; 5 are clinically cured and their bile specimens were sterile.

7. The gall-bladders of dogs contain mercurochrome eighteen hours after intravenous injection.

8. This bile is bactericidal and contains mercury.

9. Due to storage of mercurochrome in the gall-bladder it is possible to obtain its shadow in roentgen-ray films.

Several patients had films made and shadows of the gall-bladder were obtained in a few instances. The presence of gas in the hepatic flexure spoiled the picture in several cases. The shadows were obtained in cases in which the tetraiodophenolphthalein test had not shown gall-bladder concentration. Eight vesicles which did not cast a shadow with tetraiodophenolphthalein were able to retain mercurochrome and evacuate it the next morning.—*R. S. Bromer.*

Monroe, Robert T., and Emery, Edward S. Jr. The effect of irritation of the colon on the emptying time of the stomach. *Am. J. M. Sc.*, March, 1929, clxxvii, 389–394.

It is well recognized that the activity of the colon increases after the ingestion of food, but whether this is due to a true gastrocolic reflex or whether it is to be explained on Alvarez' gradient theory, is not known. The authors conclude from their review of the literature that irritation of a peritoneal surface will cause spasm of the pylorus. Under certain conditions, material can apparently make its way from the lower to the upper portions of the tract. Reverse peristalsis also seems to occur at times as a result of disturbances low down. Except for White's work there has been no attempt to determine what mechanism of the intestine needs to be involved to produce the effects observed clinically. In other words, have these disturbances been due to irritation of the mucosa or have the conditions present involved other layers of the intestinal wall? With this in mind the authors set about producing a chemical irritation of the colon and studied its effect on the emptying time of the stomach. There are numerous instances in the literature suggesting that pathology in the colon or ileocecal region may affect the gastropyloric mechanism, resulting in a prolongation of the emptying time of the stomach. Their study, undertaken on dogs to determine if a simple but severe chemical (turpentine) irritation of the mucous membrane of the colon would produce this effect, produced no change in the emptying time of the stomach. Irritation of the colonic mucosa, therefore, does not alter gastric peristalsis or the pylorus insofar as the emptying time is concerned. Whatever relation exists between disorders of the lower intestinal tract and the stomach must rest upon some other basis.—*R. S. Bromer.*

Pauli, W. E., and Sulger, E. On the bactericidal action of roentgen rays. *Strahlentherapie*, June 5, 1929, xxxii, 761–768.

The bactericidal action of roentgen rays was tested on *B. pyocyaneus* and staphylococci both in vitro and in animal experiments by producing an elevation of temperature of 4°C. (over the standard 37°C. incubator temperature) during the period of roentgen irradiation.

(1) Experiments in Vitro. The bacteria were placed on nutrient media in petri dishes and irradiated with the same dose in ovens of 37°C. and 41°C. and kept there for a period of twenty-four hours following the irradiation.

An autoregulator tube was used with 0.5 mm. Zn, 120 kv., 1.5 ma., and 23 cm. distance. In order to obtain quantitative determinations the irradiation was carried out with 8, 9, 10, 15, 20 and 25 minutes, both at 37° and 41°C.

It was found that the bactericidal action of the roentgen rays was 80 per cent higher at 41°C. than at 37°C. for *B. pyocyaneus* and 100 per cent higher for the staphylococci.

(2) Animal Experimentation. The experiments in animals (rabbits) were carried out by burying a thread (saturated with staphylococci and *B. pyocyaneus* in 1 per cent sodium chloride solution) under the skin (parallel to the cutis for a distance of 3 to 4 cm.) of both ears of the rabbits and by irradiating the right ear forty-eight hours later (at which time several small abscesses have developed)

while the ear was placed in a water bath of 41°C. The left ear, which remained unirradiated was used as control. The dose applied was 2 S.U.D. with 0.5 mm. Zn. The infection of the irradiated ear cleared up considerably sooner than the infection of the control ear.

The impression is gained that the application of roentgen irradiation over local infections at a higher temperature but which still can be tolerated by the body would lead to improved results.—*T. Leucutia.*

St. George, A. V., Gettler, Alexander O., and Muller, Ralph H. Radioactive substances in a body five years after death. *Arch. Path.*, March, 1929,, vii, 397–405.

An autopsy performed five years after death on a young girl who had died supposedly from "ulcerative stomatitis" with syphilis as a contributory cause revealed radioactive substances in all of the bones and tissues examined. The girl had been employed for a period of four years in a factory painting watch dials with luminous paint, in the process of which she "pointed" the brush between her teeth. After preparation of the bone samples and the bone and tissue ashes, these were examined for the presence of radioactive substances with the Lind electroscope and by the photographic method. Experiments were conducted to show that the bones were emitting all three of the rays of radium; alpha, beta and gamma rays. The nature of the active deposit was next determined and this was found to be radium. Quantitative determinations of the radium content of several tissue and bone ashes were made by the emanation method. From the data obtained it was estimated that the entire skeleton contained 48.282 micrograms of radium, while the total estimated radium content for entire bones, liver and lungs was 48.4179 micrograms.

From these investigations it was concluded that radium salts when absorbed find permanent lodgment in the viscera and the bones with a predilection for the latter. Radium thus absorbed by bones causes increased brittleness and necrosis.—*Karl Kornblum.*

Martland, Harrison S., and Humphries, Robert E. Osteogenic sarcoma in dial painters using luminous paint. *Arch. Path.*, March, 1929, vii, 406–417.

Two cases of osteogenic sarcoma of bone occurring in a series of 15 girls dying from the effects of radium-mesothorium poisoning are reported. Only in one of these was the diagnosis of osteogenic sarcoma proven by autopsy and histologic study. This case is reported in detail. This patient had been a painter of watch dials with luminous paint for a period of eight years. Fourteen months before death she fell and injured her right shoulder while working in a department store. Roentgenograms revealed radiation osteitis in the right humerus, the scapula and the right tarsal scaphoid. These changes were similar to those noted in the bones of other dial painters dying from the absorption of radium. Three months before death roentgenograms of the right shoulder revealed a sarcoma. At autopsy, in addition to the osteogenic sarcoma, bone marrow changes as described in other fatal cases of radium poisoning were found. Radioactivity in the bones was demonstrated by the photographic and scintillation methods and by means of an alpha electroscope.

The authors feel that the evidence offered in these 2 cases warrants the belief that the development of sarcoma was in part, at least, the result of the presence of radioactive substances in the bone. The incidence of 2 out of 15 cases is too high to be a mere coincidence. They stress the importance of the constant bombardment of the tissues by the alpha rays, a condition which never exists in roentgen or radium therapy where exposure to radiation is intermittent and the alpha rays either screened out or absorbed in the superficial layers of the skin.—*Karl Kornblum.*

Kessler, Henry H. Some medicolegal aspects of occupational disease. *Arch. Int. Med.*, June, 1929, xliii, 874–877.

In the past five years, New Jersey has experienced the occurrence of fatal cases of occupational poisonings in new industrial diseases or in new forms of old diseases, which has called attention to the present inadequate method of compensating workmen through a schedule of specific diseases. This list of occupational diseases in New Jersey includes: anthrax, poisoning from phosphorus, benzol and its homologues, wood alcohol, lead, mercury, arsenic and chromium; caisson disease and, recently, radium necrosis. The types of poisoning discussed in this paper are tetra-ethyl lead and benzol poisoning and radium necrosis. The last is of special interest to radiologists.

In 1923 the first cases of radium poisoning were referred to the rehabilitation clinic of New Jersey. One woman, aged twenty-four, had worked for seven years as a dial painter, during which time she pointed the brush she used with her lips, thereby ingesting some of the radioactive substance that had been added to the zinc sulphide paint to make it permanently luminous. Chronic anemia with extensive necrosis of the inferior maxilla developed.

Her blood picture showed profound anemia with a color index of one plus, a large cell anisocytosis with many macrocytes, a slight polychromatophilia, occasional granular basophilia and a scant number of nucleated red cells and a rare megaloblast. The blood platelets were normal, and purpura and bleeding was not elicited. The icterus index and the van den Bergh tests were negative, showing that the anemia was not due to hemolysis but to a lack of production of the ordinary blood forms. After an illness of three years, she died from a progressive anemia with extensive necrosis of the lower and upper maxillae and a terminal bronchopneumonia. Autopsy showed intense replacement of the normal adult fatty marrow by a red regenerating bone marrow. The organs were tested after incineration for radioactivity and showed storage of radioactivity in the bones to a large extent and to a lesser extent in the spleen and liver.

Since this case, 11 other patients who were exposed died; 5 others are still alive, but they are suffering from severe anemia. The disease is now included in the Workmen's Compensation law.

In view of the limited knowledge and comparatively few cases of radium necrosis that have been adequately studied, the author has been unable to set up any diagnostic standards. For the purpose of guidance he thinks the following factors must be considered:

1. History of exposure to radioactive substances.

2. Symptoms of anemia including the blood picture.

3. Local symptoms of a jaw necrosis or radiation osteitis.

4. Physical tests of radioactivity:

(*a*) Autoradiography.

(*b*) Electrometer test both to expired air in the living and to incinerated bone after death. —*R. S. Bromer.*

Samssonow, N. Influence of irradiation of the liver with roentgen rays and radium on the cancer grafts in rats. *Compt. rend. Soc. de biol.*, May 3, 1929, c, 1163–1166.

The author experimentally irradiated the liver in rats inoculated with cancer in order to study the secondary effect of the changes produced by the irradiation of the liver on the course of the cancer grafts.

The fusocellular sarcoma and the epithelioma of rats were used, the technique of irradiation being as follows: 20, 30, and 40 cm. spark gap, 3 mm. Al, 20 cm. skin target distance, 4 to 5 ma., fields 15 by 15 and 30 by 30 mm., 793 R to 2300 R (Solomon), 5 to 10 H (Holzknecht). The rats were laid on the back and the treatment was given over the liver anteriorly, while the rest of the body was protected by lead sheets of from 3 to 6 mm. thickness. Forty grafted rats (32 sarcomas and 8 epitheliomas) and 12 normal rats (control) were irradiated.

While there was practically no reaction in the normal cases, all of the grafted rats showed very severe toxic changes following the irradiation resulting in death within four to five days. During the same period there was a very rapid disappearance of the tumors which in the smaller grafts led to complete sterilization.

The experiments were repeated with radium by introducing (under anesthesia) emanation seeds (2.50 mc.) in the liver of 5 rats grafted with sarcoma. An arrest of the growth of the tumors was observed, varying over a period of from eight to twenty days.

The conclusion is reached that irradiation of the liver leads indirectly to disappearance of the carcinoma. This might be of a practical importance in the prophylactic treatment of metastases in malignant conditions.—*T. Leucutia*

Silverman, Daniel N., Denis, Willy, and Weinberger, Herbert L. On the relation of gall bladder emptying to the ingestion of fats. *Am. J. M. Sc.*, March, 1929, clxxvii, 384–385.

The present communication is a report on a series of experiments as a continuation of work previously described, in which a study was made on the relative effect of various fatty substances on the emptying of the gall-bladder. As a result of this work the conclusions were made that gall-bladder emptying was only slight following unemulsified fat (olive oil); that egg yolk produced a more rapid and complete emptying than did cream or olive oil; and that no fat ingredient contained in egg yolk was found to be specific for the gall-bladder response. Any one of the above mentioned produced emptying of the gall-bladder. The blood analysis showed no relation between the quantity of blood fat and the emptying time of the gall-bladder.

The present paper describes the results of a series of experiments in which some of the products of egg yolk and of cream were administered, in four different methods of preparation. It was found that the emptying of the gall-bladder is apparently not dependent upon fat absorption as far as can be determined by blood analyses. Since the already digested fat does not affect the gall-bladder reflex, there is suggested some relation between gall-bladder emptying and the intestinal digestion of fat.

In these experiments, the gall-bladder was visualized by the oral administration of 3.5 gm. of sodium tetraiodophenolphthalein. The patient fasting, plates were made fourteen and sixteen hours respectively after administration of the dye. The fat preparations were given by mouth and subsequent plates were made one and two hours respectively thereafter. The paper is illustrated by three series of roentgenograms.—*R. S. Bromer.*

Traut, Herbert F., The mechanism of pyelovenous backflow. *Surg., Gynec. & Obst.*, May, 1929, xlviii, 662–670.

Attention was first attracted to the so-called pyelovenous backflow by the appearance of radial shadows in roentgen pyelograms, extending outward from the kidney calyces into the parenchyma. Writers called attention to it and very correctly cautioned urologists against the use of abnormal pressures in injecting opaque solutions into the kidney pelvis, for they felt the appearance of these peculiar shadows was due to extravasation from the kidney pelvis outward into the substance of the kidney.

More recently these shadows have been produced in the kidneys of both animals and humans. In the latter, pressures of 70 mm. of mercury or less were required. Inasmuch as the kidney is known to produce secretory pressures up to 100 mm. Hg when its outlet is completely and suddenly obliterated, these results at once engage the attention of everyone interested in urologic pathology. They seem to demand further explanation as regards their meaning and their further bearing on renal pathology.

The consensus of opinion in explanation of this seems to be that the pyelovenous blackflow is a "safety valve" mechanism, whereby the kidney is saved from pressure atrophy when its normal excretory channel becomes blocked sufficiently to raise intrapelvic pressure to a dangerous degree. This is accompanied by opening up hitherto closed channels leading from the kidney pelvis directly into the venous blood stream, thus draining the urine into the renal veins and reducing a pressure which might cause harm if constant for any considerable length of time. This explanation has no analogue in human physiology and therefore at once challenges interest.

With these thoughts in mind, the author attempted experiments to demonstrate the mechanism of pyelovenous backflow, as well as its incidence and something of its relation to the normal kidney and renal physiology.

The material used was human kidneys removed at autopsy. Pressures were applied for periods of 15 minutes each, commencing at 20 mm. Hg and progressing in 20 mm. jumps. This was continued until the injected mass, made up of neutral gelatine in Locke's solution, colored with India ink, flowed freely from the renal vein, or until the cortex of the kidney showed clearly an extensive injection of the small veins beneath it, or until such a pressure was reached and maintained for such a time that it was obvious that there was to be no backflow. The ureter was ligated before the pressure was released and the kidney was placed in cold 20 per cent formalin. All kidneys used appeared to be normal in their gross appearance. The kidneys were sectioned in three different manners and a total of 36 kidneys were thus prepared.

Traut thoroughly studied the anatomy of the kidney, especially that of the region about the tip of the renal calyx, using Max Brödel's injection-corrosion specimens and the drawings with which he had made, in 1899, a study of the vascular anatomy of the kidney. The inner and outer major systems of venous anastomosis are plainly shown in these specimens. The inner venous anastomotic ring or loop lies in the peripelvic fat of the sinus renalis and forms a collar about the neck of the calyx at a point usually just below the level occupied by the tip of the papilla, so that the sharply angulated tips of the fornices of the calyces lie well above and within its circle. A comprehension of this relation is fundamental to an understanding of the mechanism of pyelovenous backflow.

Traut believes that when sufficient pressure has been exerted to rupture the renal pelvis, the dilatation has been great enough to place tension upon the thin-walled collar which often surrounds the calyx, and has been great enough to tear it. From the proximity of the tip of the fornix to these venous rings one can easily understand how, in the event of tears in both, fluid would find its way into the blood stream rapidly and in large amount. Once in the arcuate veins, the mass injects the stellate and intralobular veins to the periphery of the cortex and the venae rectae for a short distance down into the medulla and of course frequently emerges from the renal vein. He feels that this is the correct explanation of the phenomenon, having traced it serially in his injected specimens.

Twenty of the 36 kidneys came within the definition of pyelovenous backflow. This is not so high a percentage, however, as has been described by other investigators. In no

kidney was the backflow produced at pressures below 100 mm. Hg, where there was not present either some definite pathological factor, or autolysis of the kidney tissues. On the contrary, a number of fresh normal kidneys withstood pressures of at least 120 mm. Hg, without rupture of the pelvis. This would seem to indicate that pyelovenous backflow was not a normal mechanism but rather one associated with pathological changes in the tissues plus increased pelvic pressure; that increased pressure alone within the physiological limits (100 mm.) could not produce it.

The foregoing statements he believes must not be construed as minimizing the necessity for care in the amount of pressure used by those injecting kidney pelves for clinical study. In these experiments all the kidneys used appeared to be normal on gross inspection by trained pathologists. And yet some of the kidneys ruptured at pressures which were as low as 30 mm. Hg.

The clinician often has no means of knowing whether or not he is dealing with a diseased kidney, and for this reason he should always use some method of injecting the opaque solutions which will ensure safety. Radial shadows extending outward from the calyces of the kidney in the roentgen film always indicate that damage has been done.

A solution of 12.5 per cent sodium iodide solution, 45 cm. (18 in.) in height exerts a pressure of 30 mm. Hg. This pressure is always sufficient for making a pyelogram and probably exceedingly rarely, if ever, will such a pressure cause a rupture of the renal pelvis.

Because of the roentgenologist's interest in pyelography this paper is of most practical importance.—*R. S. Bromer.*

Voltz, Friedrich. The activity of the Radiological Committee of the League of Nations. *Strahlentherapie*, 1929, xxxii, 445–454.

One of the sixteen special committees of the Division of Hygiene of the League of Nations is the Cancer Committee. In the Spring of 1918, a Radiological Committee was formed as a subdivision of the Cancer Committee. The actual members of the executive board of the Radiological Committee are Heyman, Lacassagne, Tománek, Claypon and Regaud, the latter in the capacity of president of the committee. The first meeting was held in London, the second in August, 1928, in Paris, the third in October, 1928, in Stockholm, and the fourth in December, 1928, in Munich.

The working program of the committee can be summed up as follows (Regaud's plan): (1) Public and scientific propaganda for early diagnosis of cancer and thus an early and prompt application of radiation. (2) Working out of plans for scientific application of radium. It is interesting to note in this respect a comparison of the figures of five year cures in carcinomas of the cervix in the Radium Institutes of Stockholm, London, Paris and Munich where, as is well known, different methods of procedure were used and still practically identical results were obtained; this indicating that a systematic and a rigidly scientific application of radiation is of paramount importance. (3) Advice to different clinics and institutes as regards equipment and the necessary supplies for adequate radiation therapy. The Radium Institute of Paris is provided with 7 grams of radium element, 4 grams of which are used for external applications, 1 gram for the production of radon and 2 grams in the form of local applications. Radiumhemmet in Stockholm possesses 2.5 grams of radium element which recently was increased by a private donation to 6 grams and on the occasion of the seventieth birthday of the King of Sweden to 12 grams. The Radium Institute of Munich is supplied with 500 mg. (4) International standardization of all statistical publications, this applying especially to the description of dosages, as well as to the classification of the different diseases. (5) The placing of certain scientific investigations on a common international basis.

The first report of the committee (prepared by Heyman, Lacassagne and Voltz), which has already been published, deals with the grouping of the cases, the standardization of the statistics and normalization of the doses. In a later report the criteria and conditions of systematic radiation therapy, as well as a critical survey of the methods used at the institutes of Paris, Stockholm and Munich and the recently completed noteworthy statistics of Lane-Claypon of London will be given. It is hoped that by this intimate cooperation a clearer understanding of irradiation conditions will be brought about.—*T. Leucutia.*